



ISA workshop 2014 Nov.24-29 in Korea

# The Outline of Environmental Survey conducted by JOGMEC

-the sediment sampling for macrofauna-

Teruyoshi Narita and Nobuyuki Okamoto

Japan Oil, Gas and Metals National Corporation

## Japan Oil, Gas and Metals National Corporation (JOGMEC is abbreviated name)

Established: February 29, 2004

[succeeded the functions of Japan National Oil Corporation(JNOC)  
and Metal Mining Agency of Japan(MMAJ) ]

President: Hirobumi Kawano

Capital: 690 Billion Yen (As of July 2014)

### Mission

Securing Stable Supply of Oil, Natural Gas, Mineral Resources and Coal for Japanese Industries and Citizens

### Activities

Oil & Gas Upstream  
Investment and  
Research &  
Development



Metals Strategy &  
Exploration, and  
Technology  
Development



Stockpiling



Mine Pollution  
Control



Coal Strategy &  
Exploration, and  
Technological  
Support



Geothermal  
Resources  
Development



# JOGMEC's Global Activities

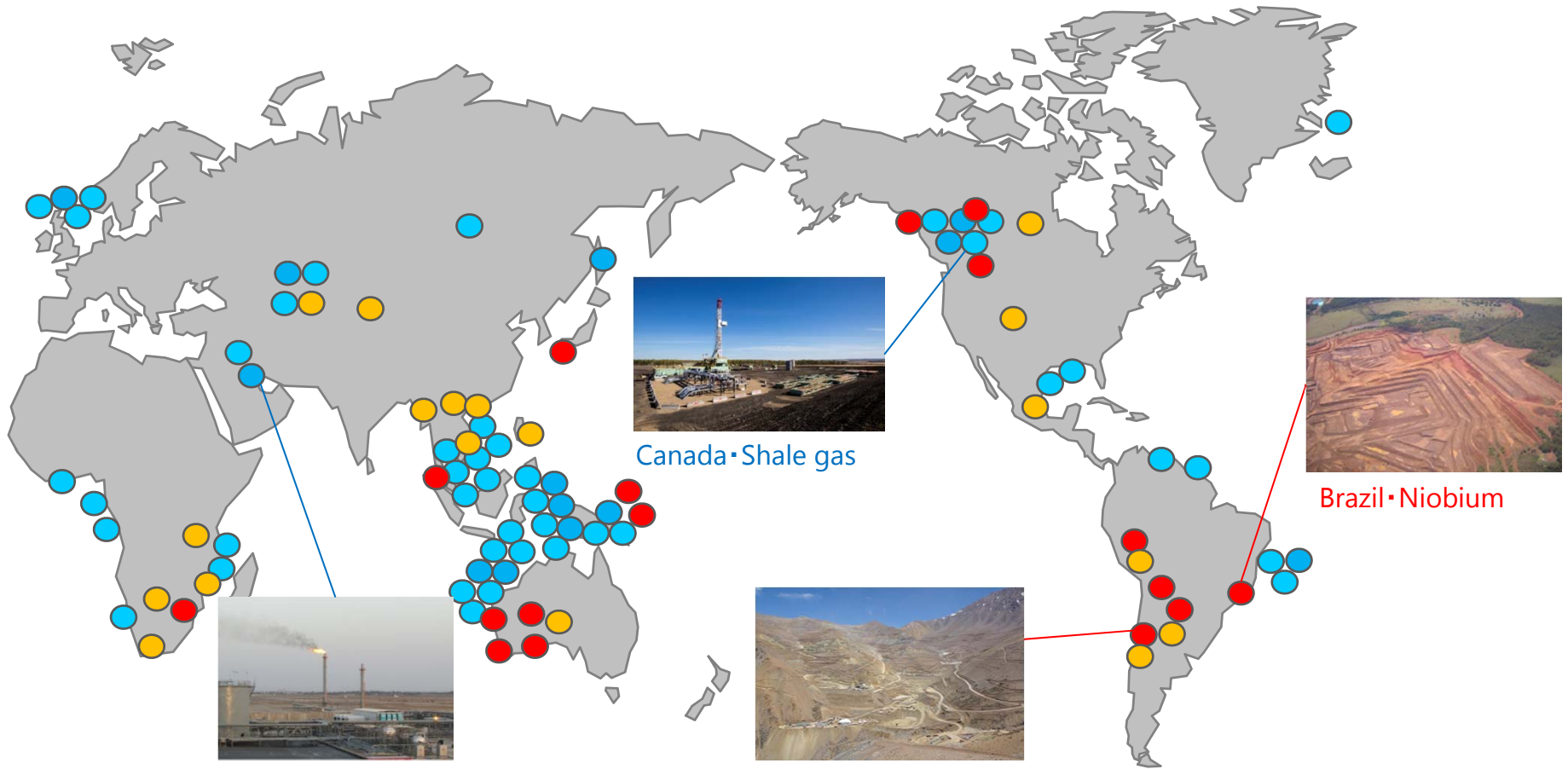
## Oil & Gas , Metals



**Oil & Gas 45 projects**  
Equity capital projects

**Metals 42 projects**  
Equity capital, loan and guarantee 24 projects

18 Joint surveys



Iraq • Oil

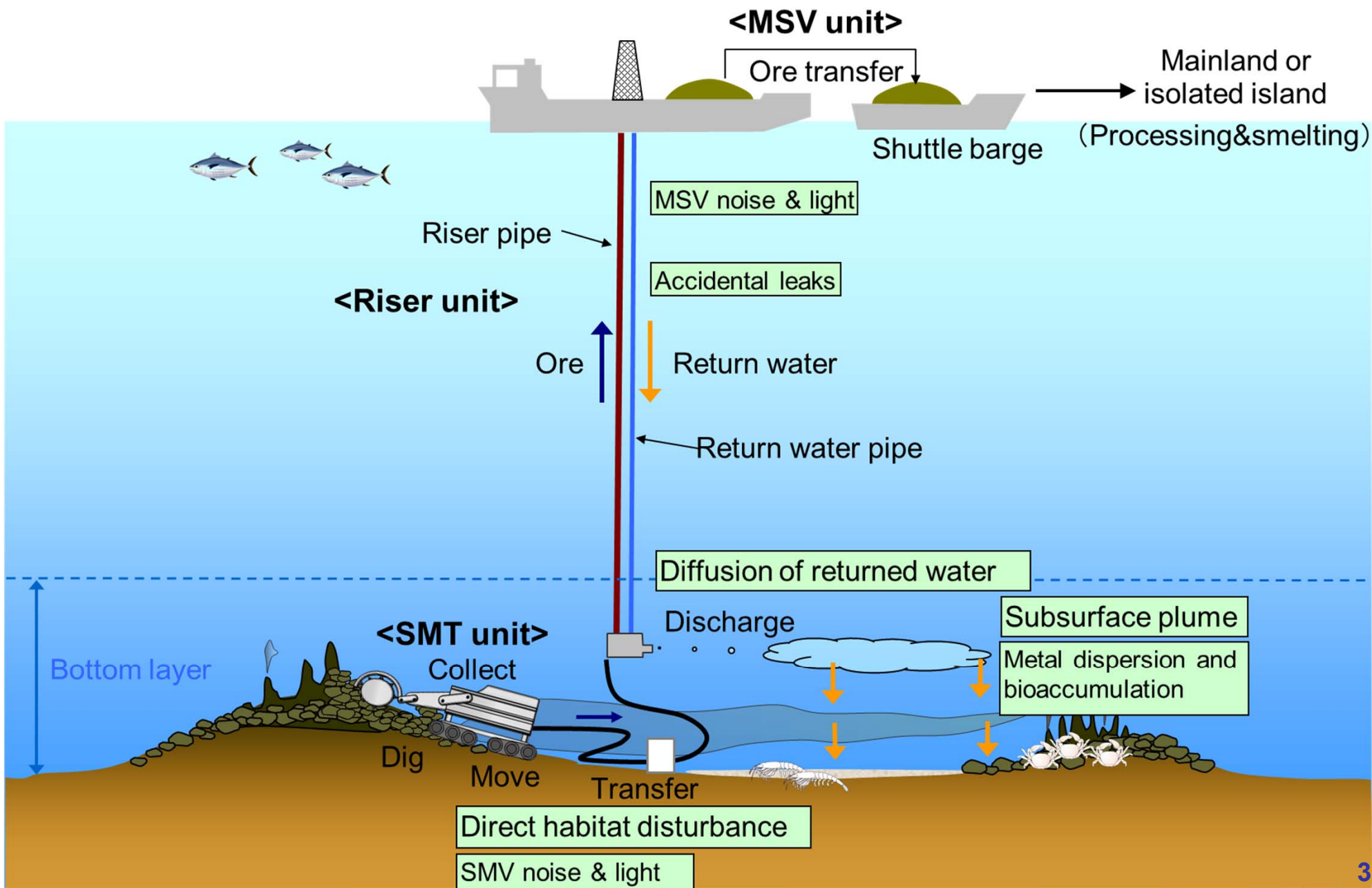
Canada • Shale gas

Chile • Copper

Brazil • Niobium

As of March 31, 2014

# Potential impacts of deep sea mining



① Seafloor Massive Sulphides (SMS)  
(2008 fiscal year~)

② Cobalt-rich Ferromanganese Crusts  
(1997 fiscal year~)

③ Rare earth sediment  
(2014 fiscal year~ )

Only current survey and water sampling

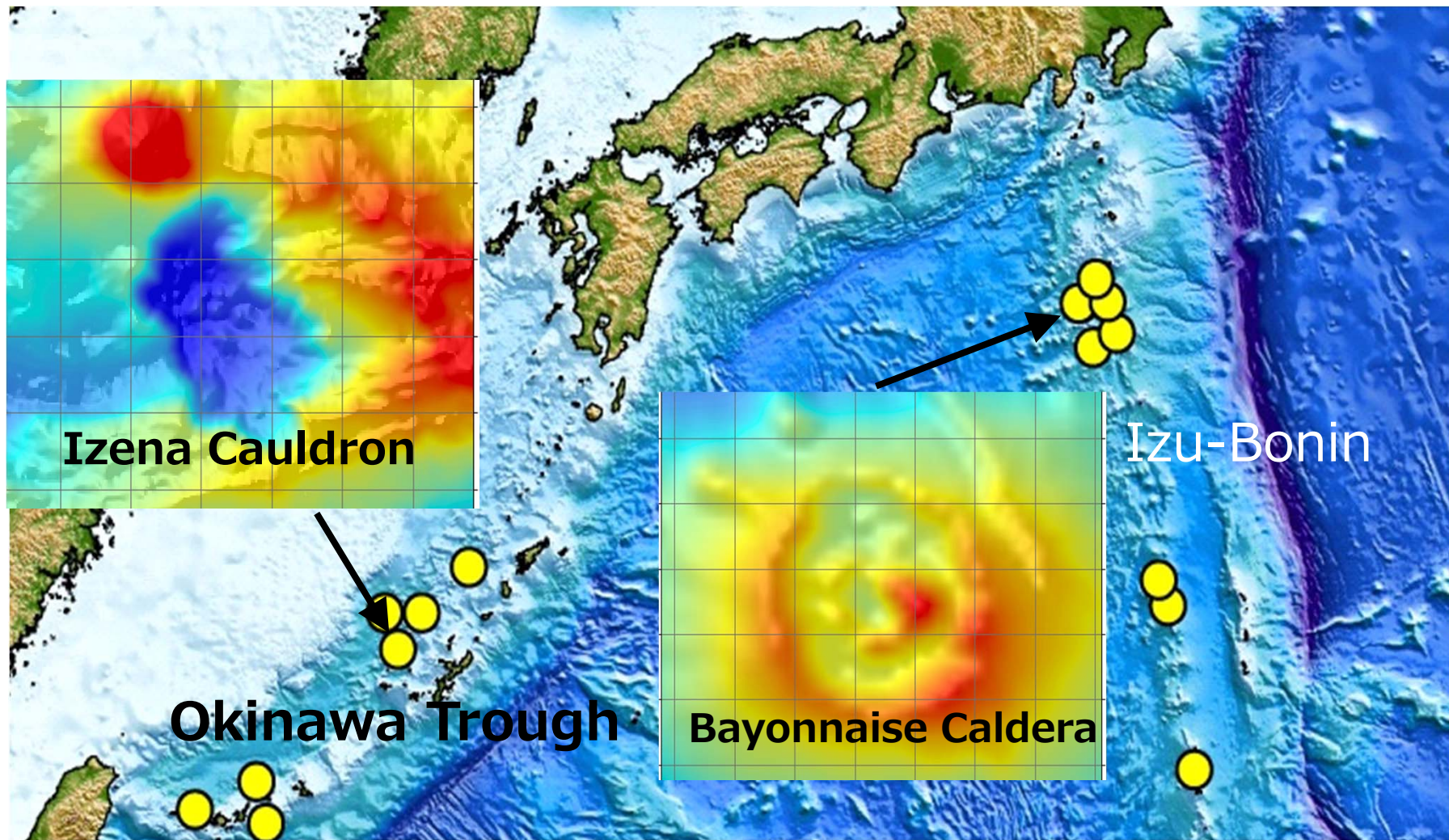


JOGMEC is conducting Environmental baseline survey in the Area where above minerals present.

# Seafloor Massive Sulphides (SMS)

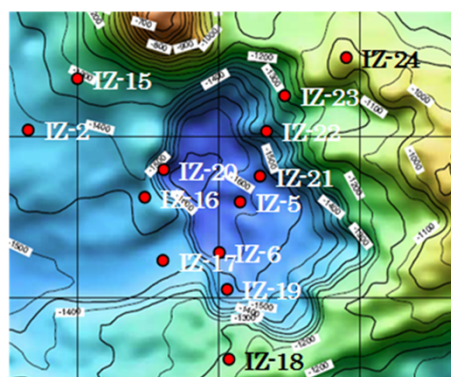
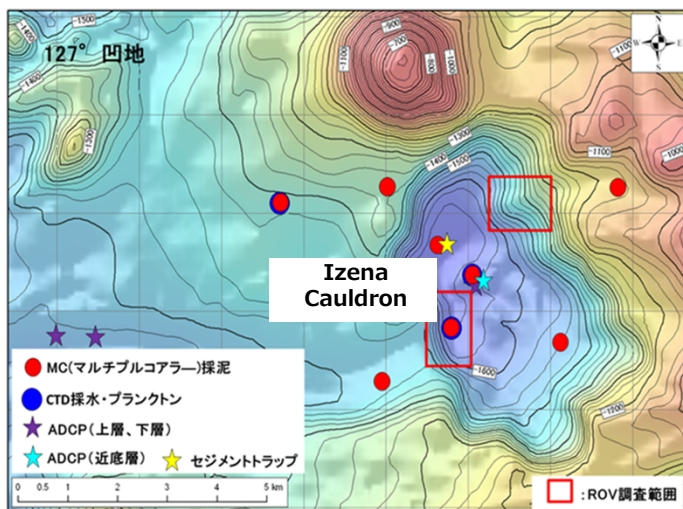
# Survey Area

The location of the Izena Cauldron and Bayonnaise Caldera



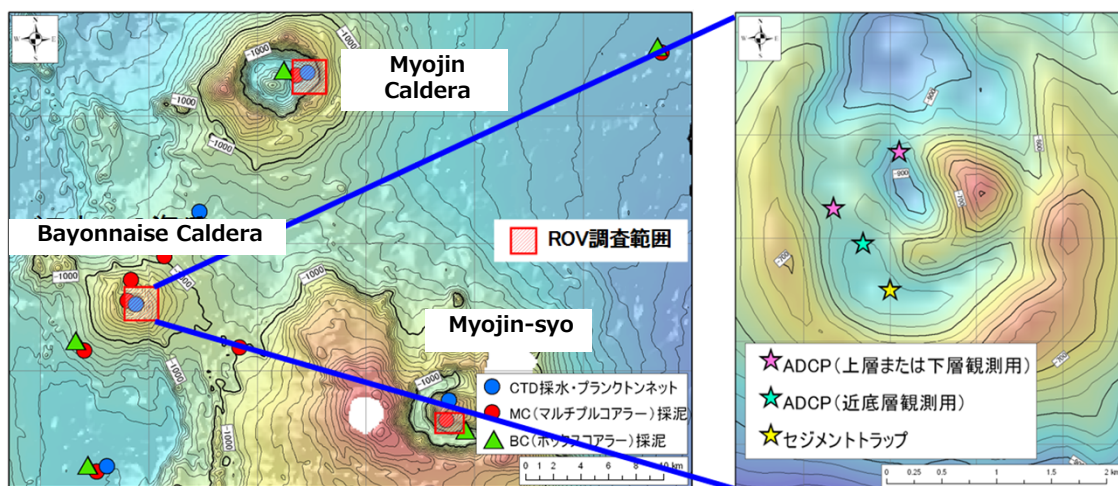
# Survey Area

## <Izena Cauldron>



Water sampling point in 2011

## <Izu-Bonin>

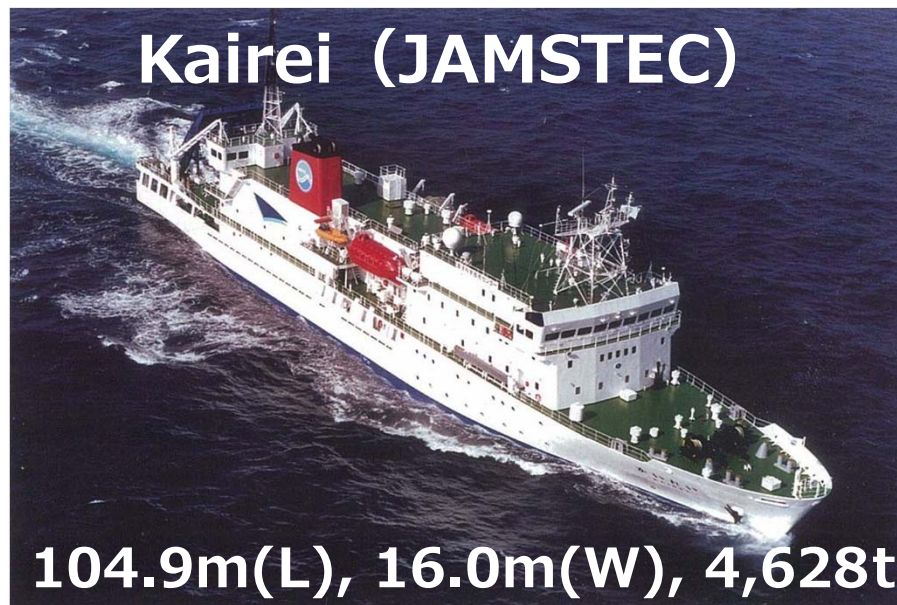


- In Izena Cauldron, the sediment samplings were carried out 1-2 times/year at inside and outside of Cauldron from 2008 to 2014 fiscal year.

- In Izu-Bonin, they were carried out from 2008 to 2010 fiscal year.



# Research Vessels



Total number of 27 cruises



# Environmental Baseline Survey Items

## Organisms

### Water Column

Bacteria  
 Chemosynthetic microbe  
 Phytoplankton  
 Zooplankton

### Sediment

Bacteria  
 Nanofauna  
 Meiofauna  
Macrofauna  
 Megafauna

## Physical factor

Current direction & velocity  
 Water temperature  
 Salinity Turbidity

## Chemical factor

### Water Column

Trace metals  
 Organic matter  
 Nutrients  
 H<sub>2</sub>S  
 CH<sub>4</sub>, CO<sub>2</sub>  
 DO

### Near bottom /pore water

Trace metals  
 Nutrients  
 CH<sub>4</sub> H<sub>2</sub>S

### Flux

Mass flux  
 Organic matter

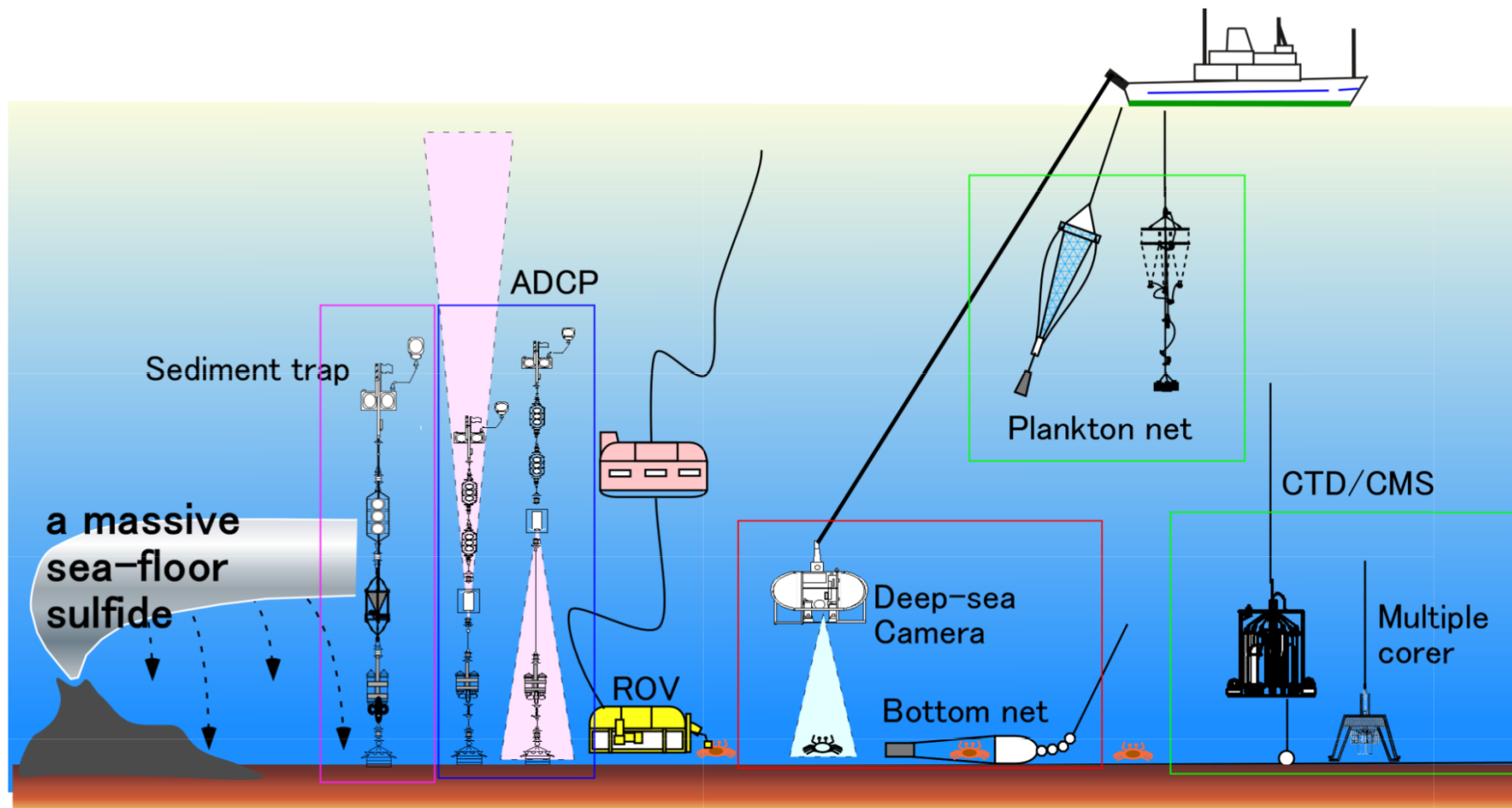
### Sediment

Trace metals  
 Sulfide  
 Organic matter  
 Grain size  
 Density  
 Water content

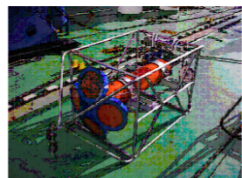
### Megafauna

Stable Isotope  
 Metal content

# Schematic image of the baseline survey



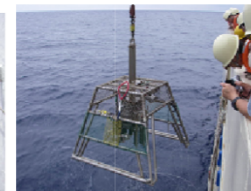
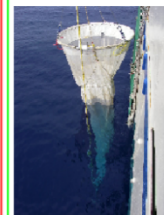
settling particle flux



current condition

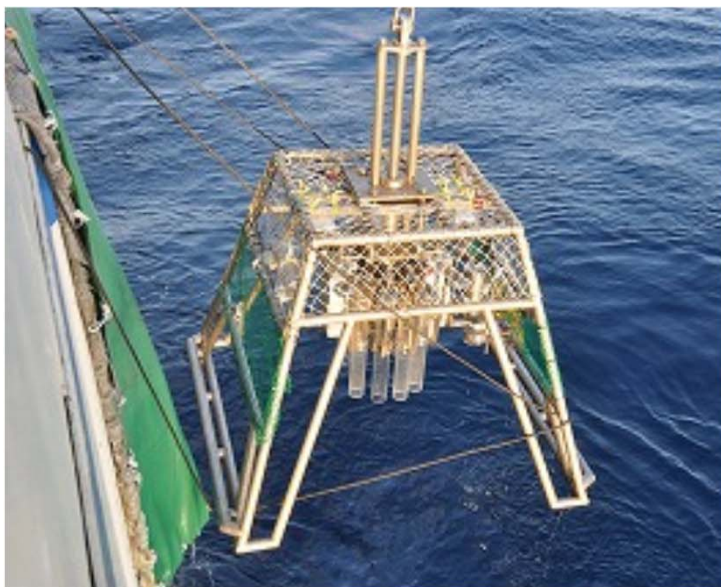


Mega benthos



water quality, chemical composition of sediment, plankton, benthos

# Multiple corer



Multiple corer (MC)



Cutting core



Transverse section of core

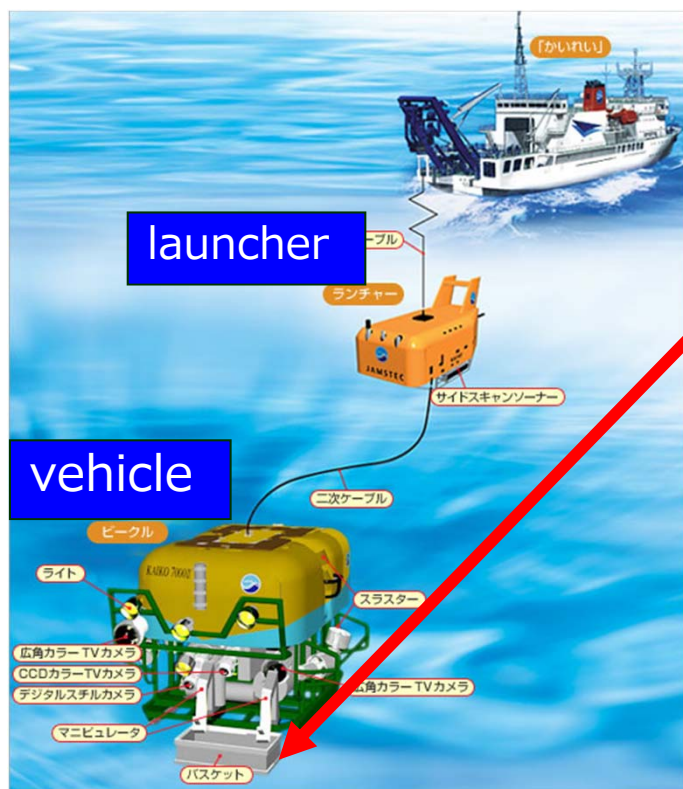


Collected core samples

- Core samples were cut into 5 layers such as surface-0.5cm, 0.5-1cm, 1-2cm, 2-3cm, 3-5cm.
- Macrofauna samples for morphological identification were fixed by 10% formalin neutral buffer solution contained rose bengal, and those for gene analysis were fixed approximately 100% ethanol.
- The definition of macrofauna size is  $>250\mu\text{m}$ . (We unified categorization of past research to examine the interannual variations of macrofauna.)

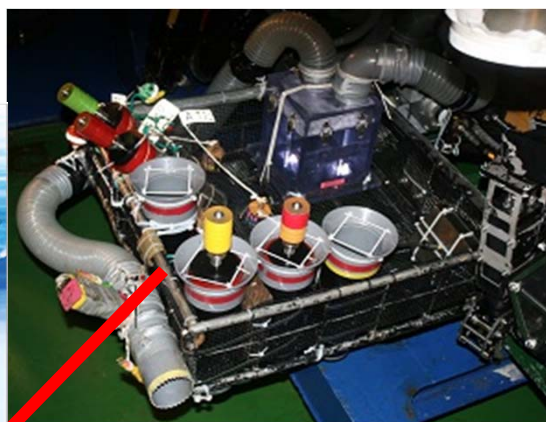
# ROV: Remotely Operated Vehicle

- ROV is useful to bottom sampling in bedrock dominance sites that MC can not be used.
- Sampling by choosing a suitable site while confirming the camera image.

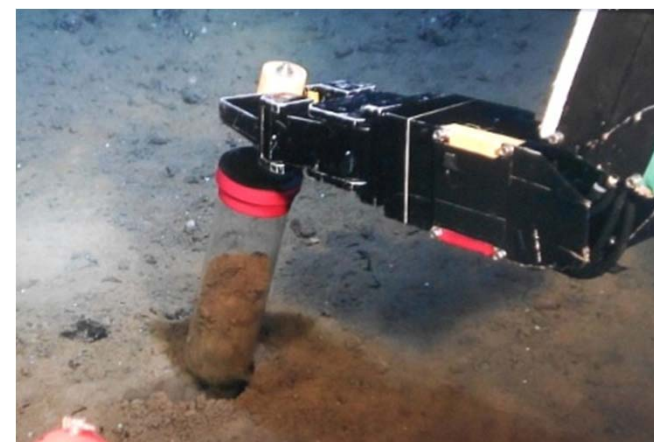


Kaiko 7000 II (JAMSTEC)

<http://www.jamstec.go.jp/j/about/equipment/ships/kaiko7000.html>



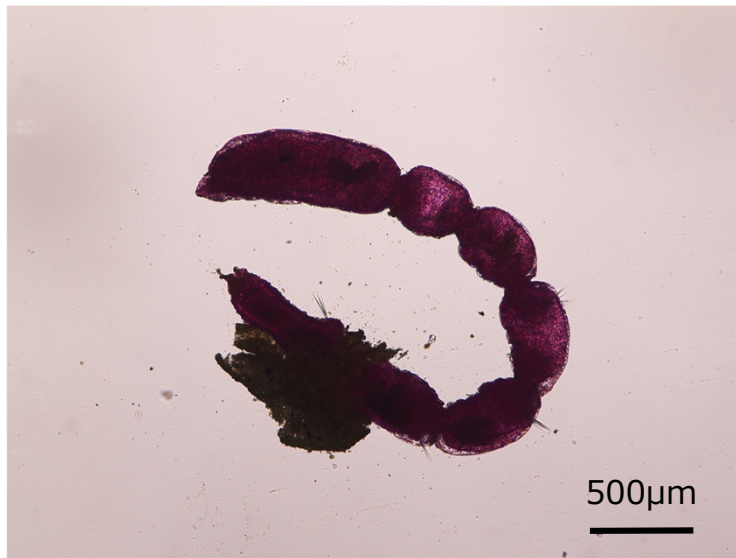
ROV payload



Collection of sediment by push corer

- Collection of sediment by ROV conducted since 2012 fiscal year.
- Sediment samples both organisms (bacteria, nano, meio, macrofauna) and chemical factors were collected by using the six push-corers mounted in ROV payload.
- Core processing method as well as the MC.

# The dominant taxa of macrofauna in SMS area



Maldanidae: Polychaeta



Gastropoda: Mollusca



Tanaidacea: Crustacea

- Formalin fixed samples were conducted morphological identification by using microscopy. The identification kept lower taxonomic resolution.
- In Izena Cauldron, 7 phyla, 7 classes, 23 orders, 24 families and 3genera of animals were identified. In Izu-Boninin, 9 phyla and 13 classes of animals were identified. The dominant taxa both Izena Cauldron and Izu-Bonin were Polychaeta and Crustacea etc.

# Results of identification of macrofauna in Izena

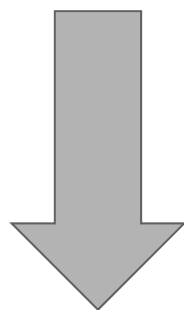
Phylum	Class	Order	Family	Genus	
Foraminifera	Foraminifera	Foraminifera(1)			
		Foraminifera(2)			
Nemertea					
Nematoda					
Mollusca	Bivalvia	Nuculoida	Nuculidae		
		Mytiloida	Mytilidae		
		Pholadomyoida	Cuspidariidae		
		Nuculoida	Nuculanidae		
	Gastropoda	Vetigastropoda	Skeneidae		
Annelida	Polychaeta	Phyllodocida	Sigalionidae		
			Hesionidae		
			Syllidae	Exogoninae	
			Cirratulida	Cirratulidae	
			Eunicidae	Onuphidae	
			Orbiniida	Orbiniidae	
				Paraonidae	
			Spionida	Spionidae	
			Flabelligerida	Flabelligeridae	
			Capiteliida	Capitellidae	
				Maldanidae	Clymenura sp.
			Terebellida	Ampharetidae	
				Terebellidae	Terebellides sp.
	Sabellida	Sabellidae	Poecilochaetus sp.		

Phylum	Class	Order	Family	Genus	
Arthropoda	Ostracoda	Crustacea	Cumacea		
			Tanaidacea		
			Isopoda(1)		
			Isopoda(2)		
			Isopoda(3)		
			Isopoda(4)		
			Anthuroidea	Paranthurida	
			Gammaridea		
				Ampeliscidae	
				Phoxocephalidae	
	Oedicerotidae				
	Caprellidea	Caprellidae			
	Harpacticoida(C)				
Vertebrate	Ascidiacea				

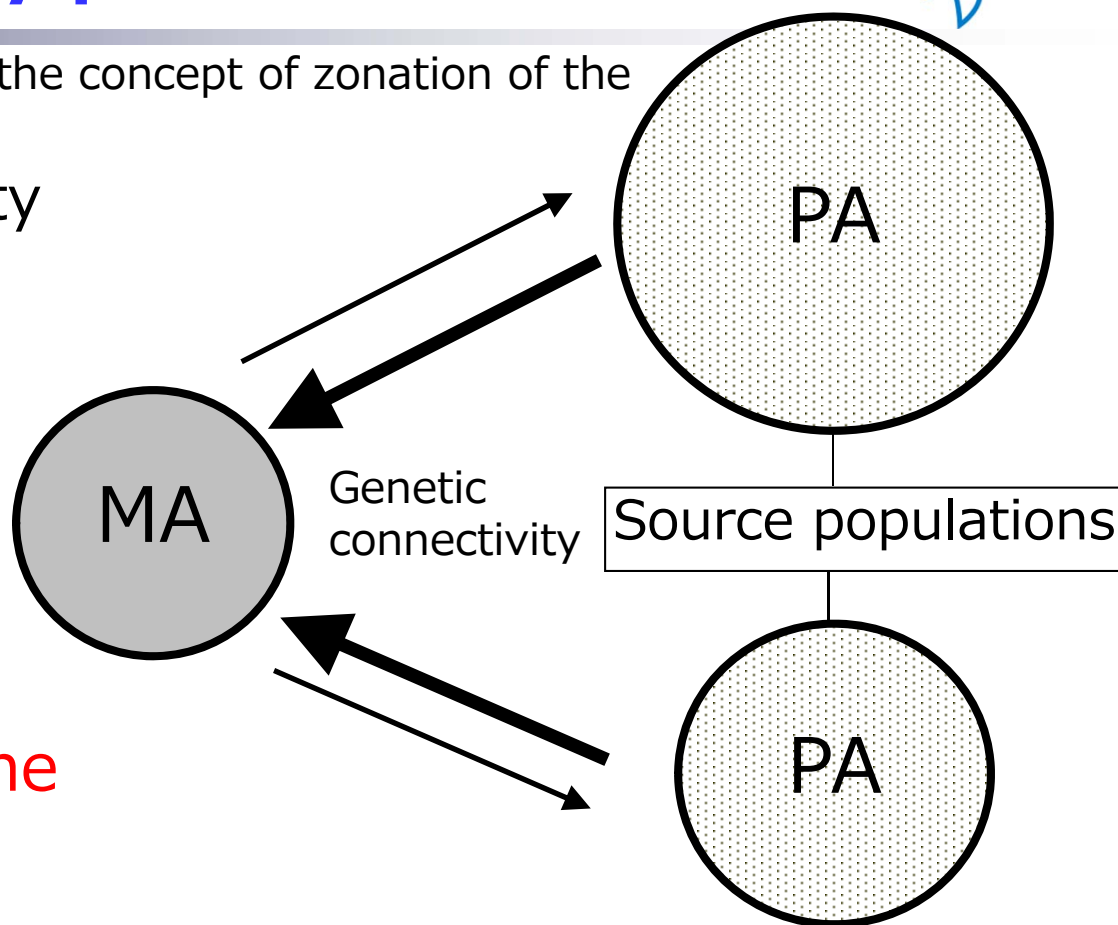
# Strategy of biodiversity preservation

To conserve the biodiversity, we consider the concept of zonation of the protected and mining areas.

- Confirm genetic connectivity between areas
- Protect source populations



- Loss of biodiversity of the area will be minimized
- Replenishment of populations is expected in a mined area



PA: Protected area  
MA: Mining area

Based on the above concepts, the genetic analysis of dominant **meiofauna** such as nematoda collected in some sites in Izena Cauldron is conducted.



# The dominant Nematoda



*Halalaimus* sp. 2



*Longicyatholaimus* sp.



*Leptolaimus* sp.



*Longicyatholaimus* sp. 2



*Leptolaimus* sp. 2



*Molgolaimus* sp.

- Firstly, gene analysis of meiofauna samples was performed because macrofauna samples are small volume.
- Formalin fixed nematoda samples were conducted morphological identification by using microscopy.
- Ethanol fixed nematoda samples were sorted by 1 individuals and the gene analysis of 18S rRNA were conducted.
- In the result of homology search of the DNA database, 1 phyla, 3 families and 7 genera of nematoda were identified (*Nematoda*, *Comesomatidae*, *Oncholaimidae*, *Thoracostomopsidae*, *Dichromadora* sp., *Leptolaimus* sp., *Sabatieria* sp., *Thalassoalaimus* sp., *Phanodermopsis* sp., *Sphaerolaimus* sp., *Bathyeurystomina* sp.).

# Cobalt-rich Ferromanganese Crusts

# The acquirement for exploration rights for crust in high sea

In 27<sup>th</sup> January 2014, the exploration contract for 15 years of the cobalt-rich ferromanganese crusts (CRC) on high sea area located in Minamitorishima of southeast off the coast about 600km was signed between JOGMEC and the ISA.



Vice-secretary general,  
Rodge (ISA)



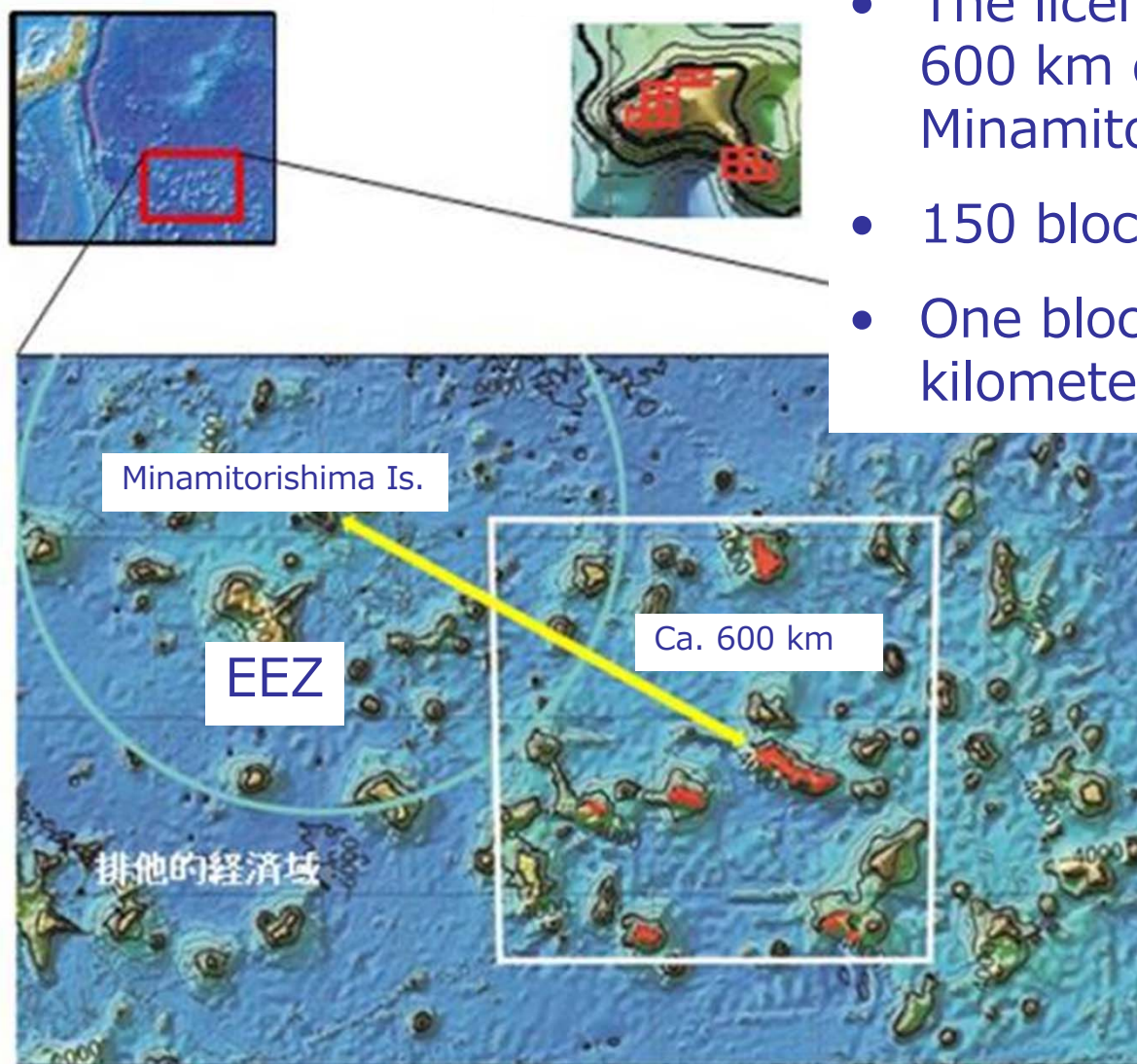
President Kawano  
(JOGMEC )

Secretary general  
Odunton  
(ISA)

Senior Vice Minister  
of METI,  
Matsushima  
(at that time)

The signing ceremony at the Ministry of Economy, Trade and Industry (METI)

# Japan's exploration area of CRC



- The license area is about 600 km distance from Minamitorishima.
- 150 blocks were licensed.
- One block is 20 kilometers square.

# Preliminary baseline studies for exploration of CRC

- Preliminary baseline studies of current, water quality, sediments and biology since 1997

- Long-term current/flux survey by ADCP/Sediment Trap
- Video observation for megafauna by FDC
- Vertical water column survey of water quality by CTD
- Sediment survey by MC

Survey	Instrument	Fiscal year																
		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
		Seamout A	Seamout A	Seamout A	Seamout A	Seamout A	Seamout A	Seamout A	Seamout A	Seamout A	Seamout B	Seamout B	Seamout B	Seamout B	Seamout B, C, D	Seamout B	Seamout B	Seamout E
Water current	current meter						↔					↔				↔		
	ADCP																	
Particle flux	Sediment trap						↔					↔				↔		
Temperature	CTD RO profiler							•	•	•	•	•	•					
Salinity								•	•	•	•	•	•					
DO									•	•	•	•	•					
NH4-N									•	•	•							
PO4-P									•	•	•			•				
NO2-N									•	•	•							
NO3-N									•	•	•							
SiO2-Si									•	•	•				•			
Chl-a									•	•	•							
TOC															•			
Silica	MC	•	•	•	•			•	•	•	•	•	•	•				
Opal		•	•	•	•	•	•	•	•	•	•	•	•	•				
CaCO3		•	•	•	•	•	•	•	•	•	•	•	•	•				
Water current		•	•	•	•	•	•	•	•	•	•	•	•	•				
TOC		•	•	•	•	•	•	•	•	•	•	•	•	•				
T-N		•	•	•	•	•	•	•	•	•	•	•	•	•				
<sup>254</sup> TH		•																
Graine size		•									•	•	•	•				
Bacteria		•	•	•	•	•	•	•	•	•	•	•	•	•				
Nanobenthos			•	•	•	•	•	•	•	•	•	•	•	•				
Meiobenthos			•	•	•	•	•	•	•	•	•	•	•	•				
Mcrobenthos				•	•	•	•	•	•	•	•	•	•	•				
Megafauna		Deep-tow														•		•
Near-bottom fauna		Sled net												•	•			

# The dominant taxa of macrofauna in CRC area



Sipuncula



Paraonidae



Sabellidae

- Samples were collected at flat topped seamount (Guyot) by MC (2-3 sites per cruise). Core processing method as well as the SMS.
- All samples were fixed 10% formalin neutral buffer solution contained rose bengal, and conducted morphological identification by using microscopy. The identification kept lower taxonomic resolution.
- In Seamount A, 6 phyla and 5-8 classes of animals were identified. Sipuncula and Polychaeta were dominant taxa.

# Summary

1. The dominant taxa both Izena Cauldron and Izu-Bonin were Polychaeta and Crustacea etc.
2. Sipuncula and Polychaeta were dominant taxa in CRC area.
3. JOGMEC will continue to conduct the environmental baseline survey at the licensed CRC mining area in accordance with the SMS area .

Thank you  
Merci Beaucoup  
Gracias  
감사합니다

谢谢  
Спасибо  
أ – شُكْرًا.

