
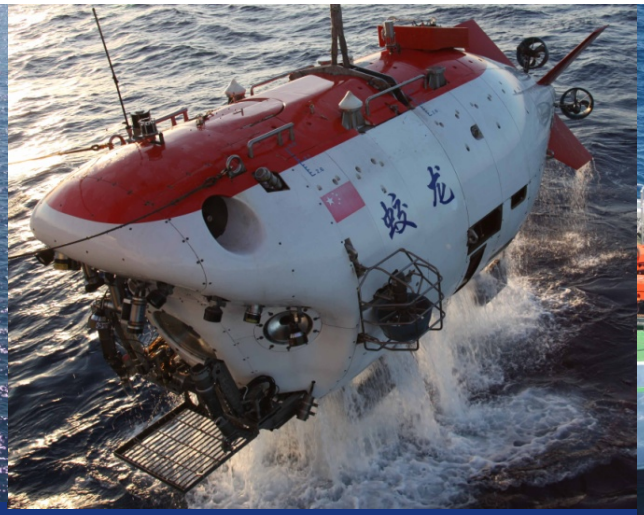


Resources of the Area and industrial application of deep-seabed minerals

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China Ocean Mineral Resources R&D Association

lixy@comra.org

10 September, 2019

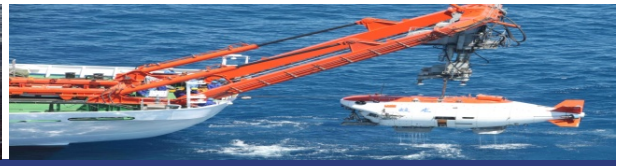
ASEAN & BIMSTEC workshop on Deep Seabed Resources and Blue Economy, in Nay Pyi Taw, Myanmar



OUTLINES

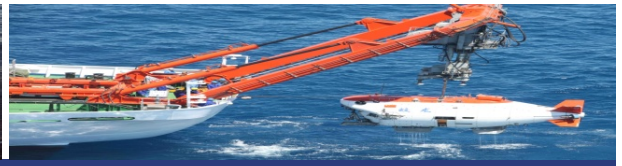
- Deep Seabed Resources
- Industrial Application of Resources
- ISA –CHINA JTRC





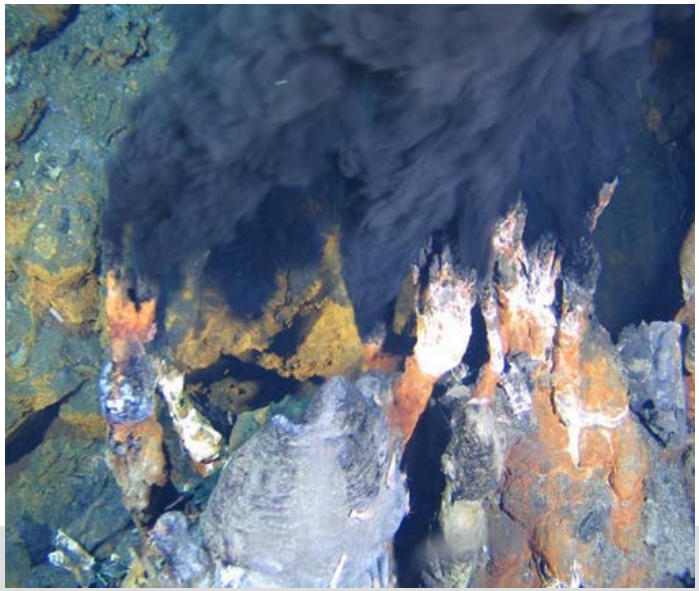
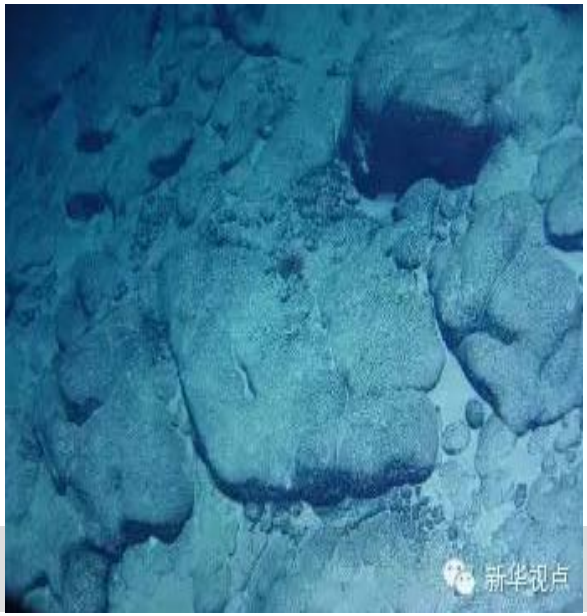
1. Deep Seabed Resources

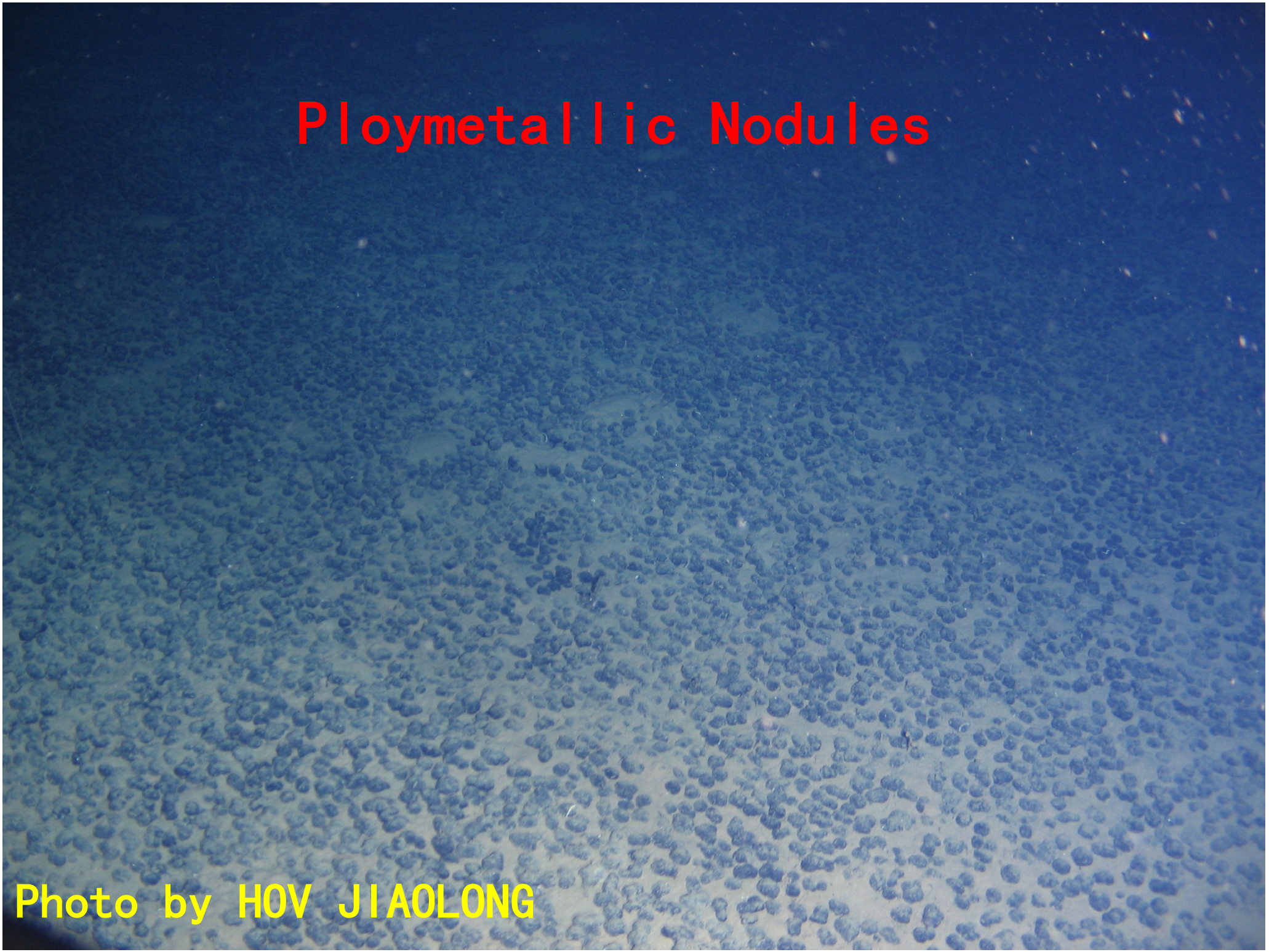




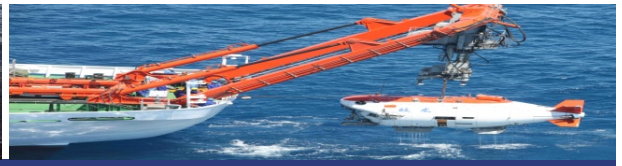
1. Deep Seabed Resources

- Ploymetallic Nodules
- Cobalt-rich Ferromanganese Crusts
- Ploymetallic sulphides
- **Other resources？**


Ploymetallic Nodules
Photo by HOV JIAOLONG



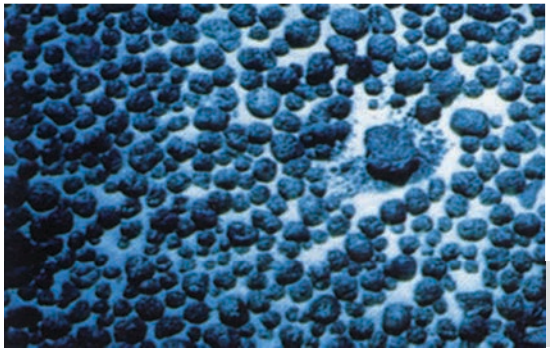


1. Deep Seabed Resources

➢Ploymetallic Nodules

- **Main Elements**：More than 60 elements to be discovered. Copper, Nickel, Cobalt, Manganese are industrially valuable, Besides, there are still trace amounts of Molybdenum, Platinum, REE and other base metals.

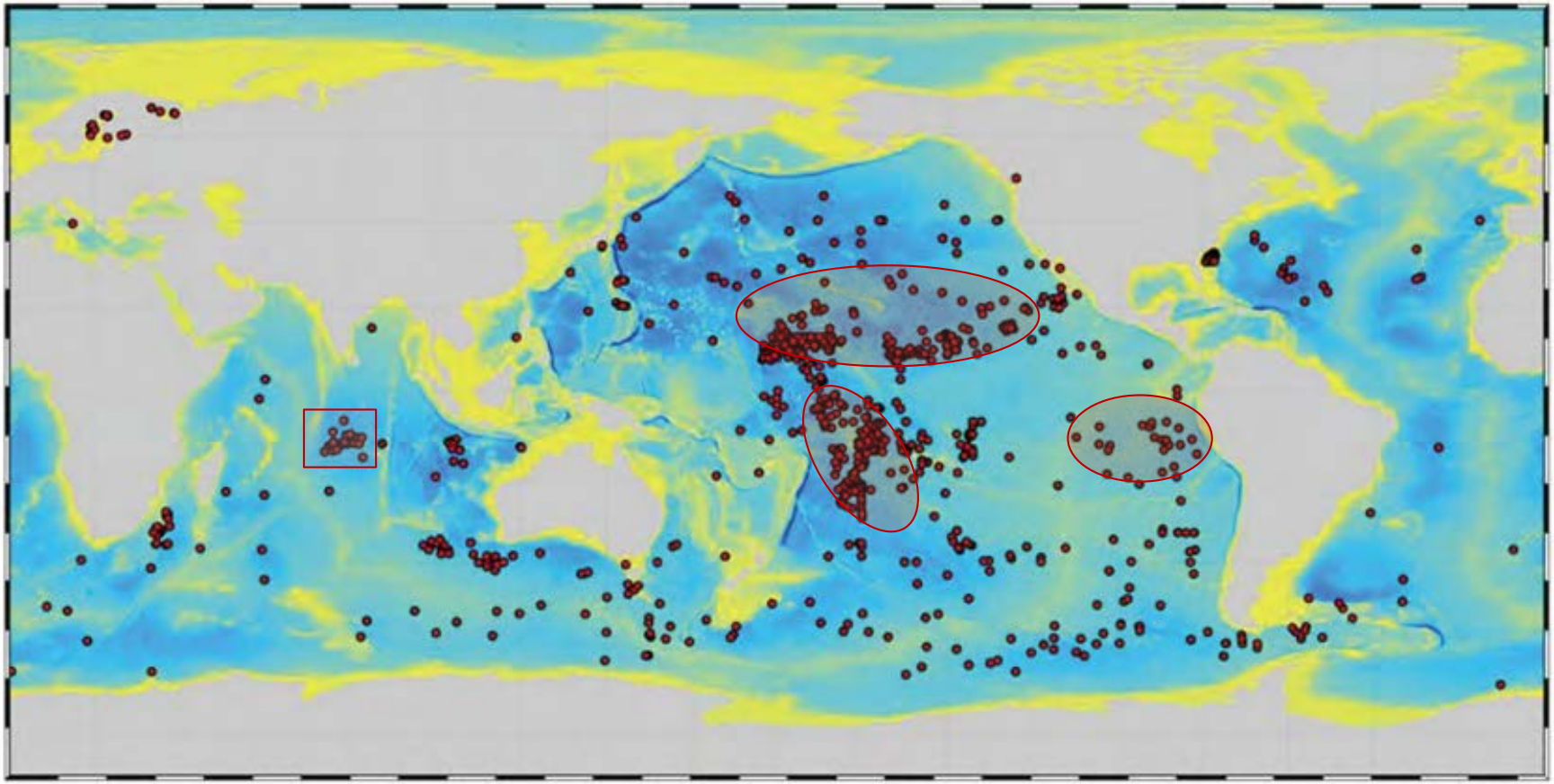
- **Distribution Character**: Deep sea basin with a water depth of 3500-6500 meters. The size generally is 0.5-10cm in diameter.



Polymetallic nodules. (Christina Loarie)

Cross-section of a Polymetallic nodule





- **Distribution area:** Clarion-Cripperton Fracture Zone in the Pacific Ocean, Peru Basin, Penglin Basin, Indian Ocean with high abundance.



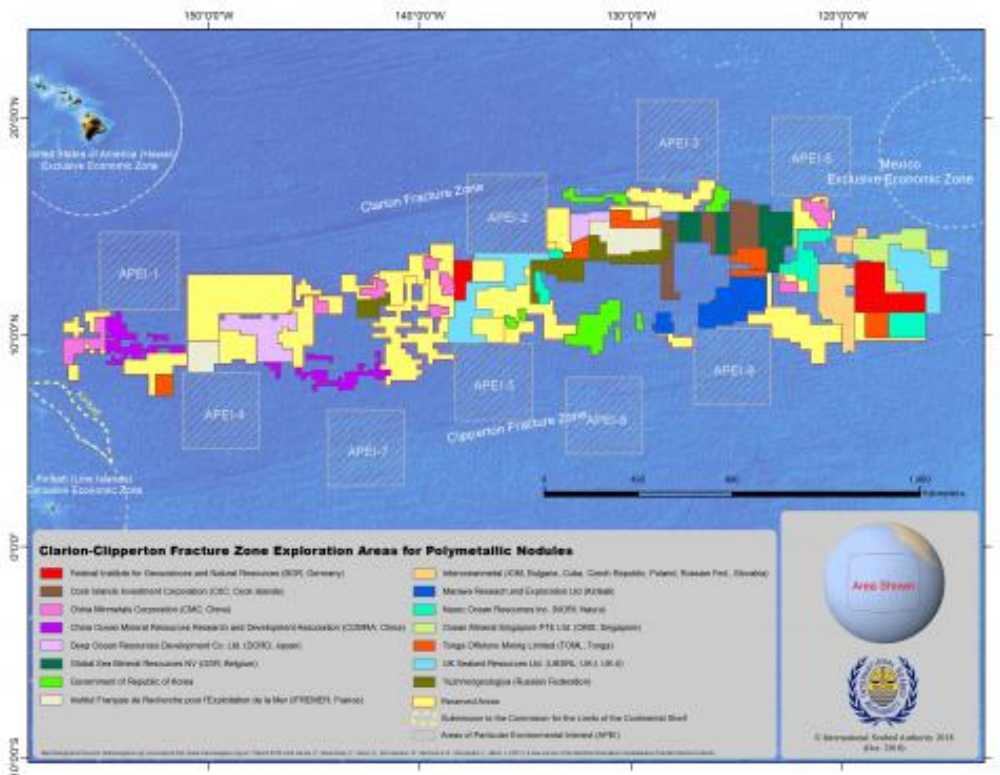
1. Deep Seabed Resources

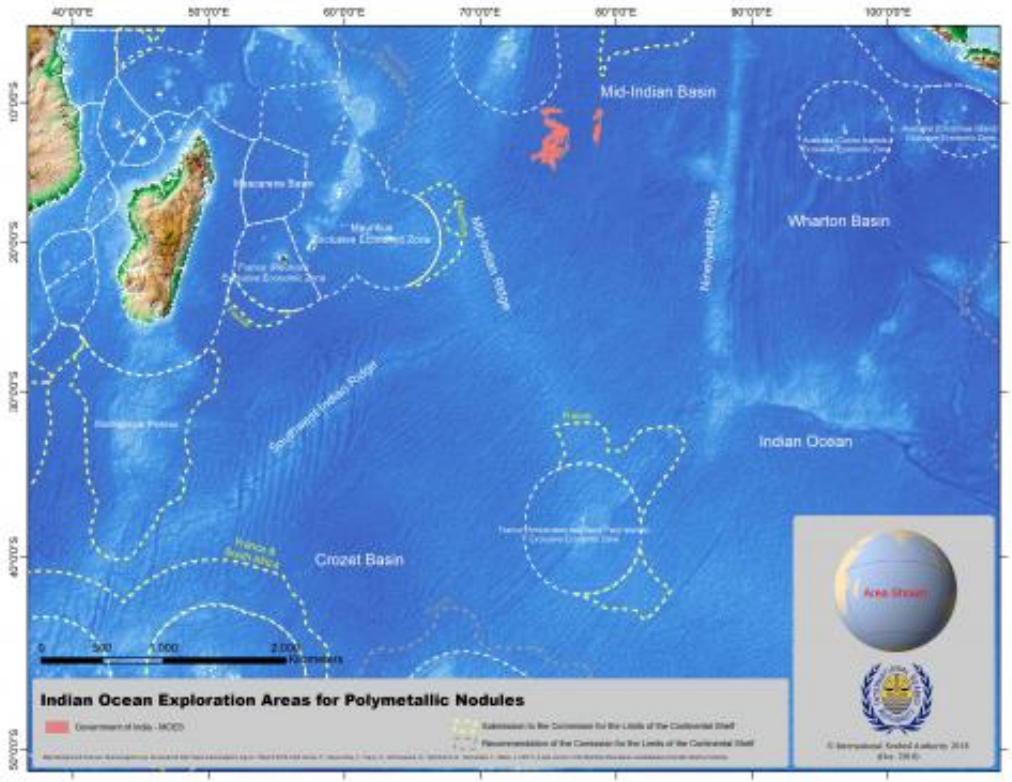
➢Ploymetallic Nodules

AREA		CC Zone	Central Pacific
Metal Grade (%)	Manganese	~30	~20
	Copper	~1.5	~1
	Cobalt	~0.4	~0.4
	Nickel	~1	~0.5
Sum (Cu+Co+Ni)		~3	~2



1. Deep Seabed Resources





- 17 Contracts Areas before July 2019
- India, Singapore is the sponsoring states

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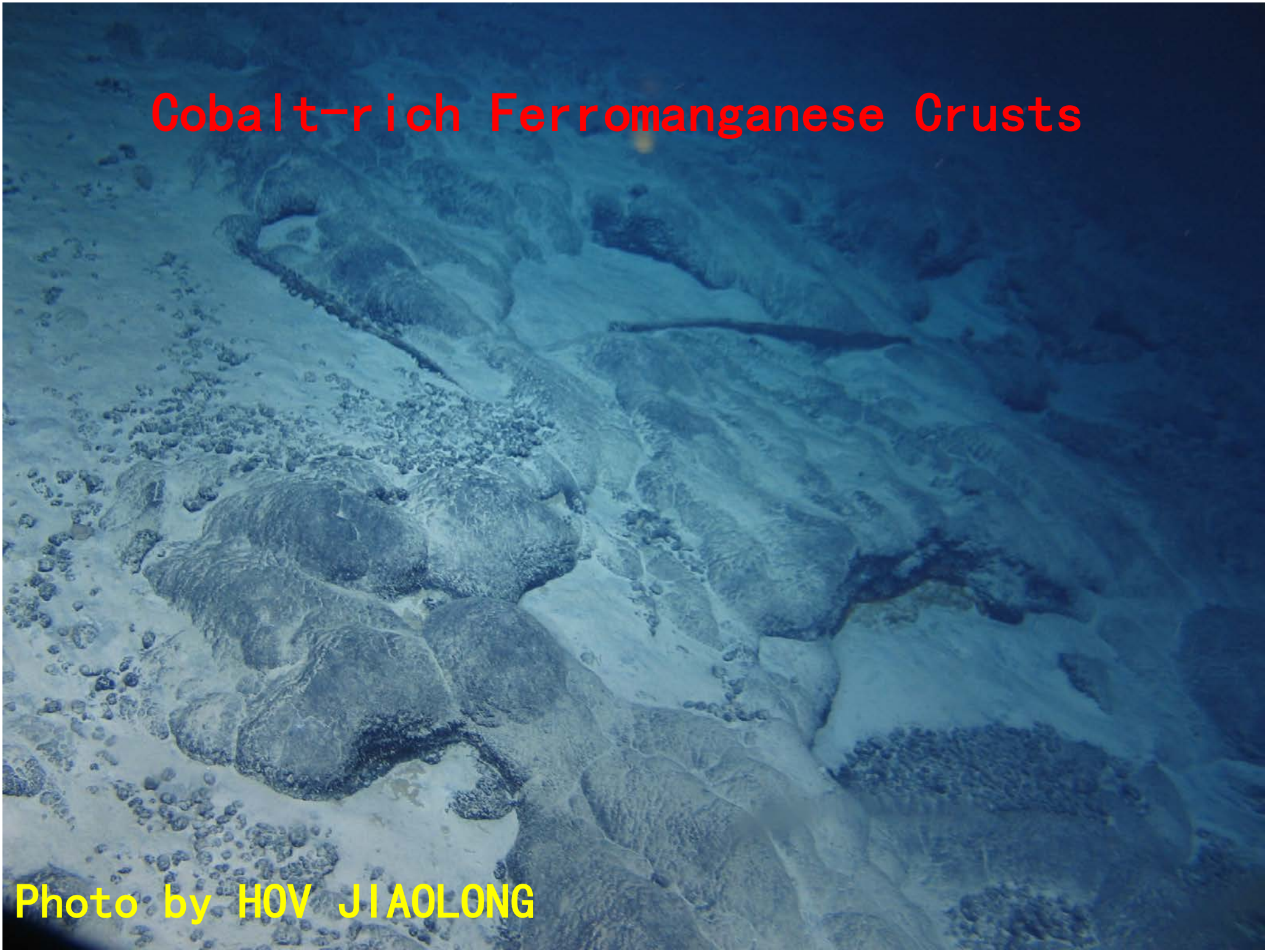
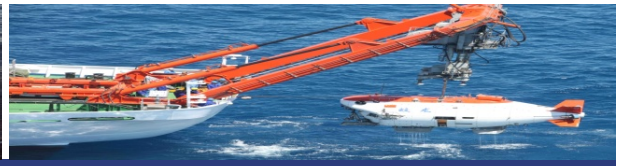

Cobalt-rich Ferromanganese Crusts
Photo by HOV JIAOLONG

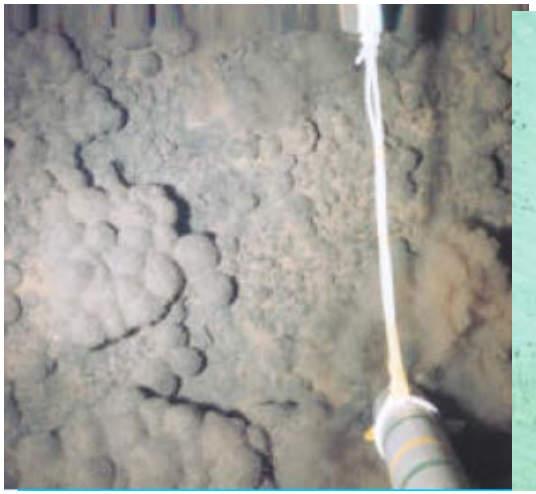


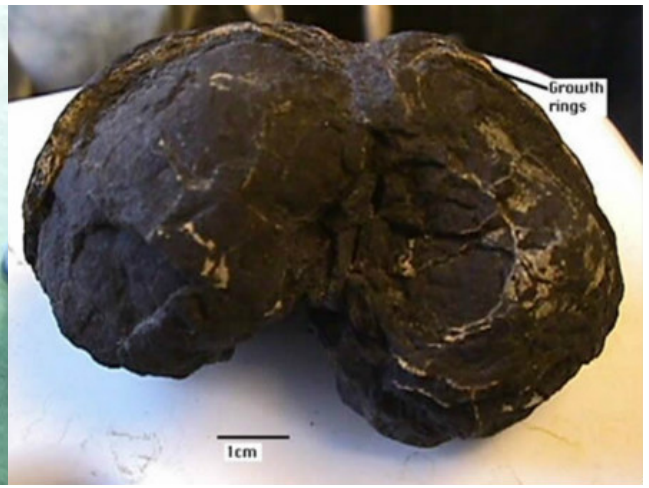


1. Deep Seabed Resources

➢Cobalt-rich Ferromanganese Crusts

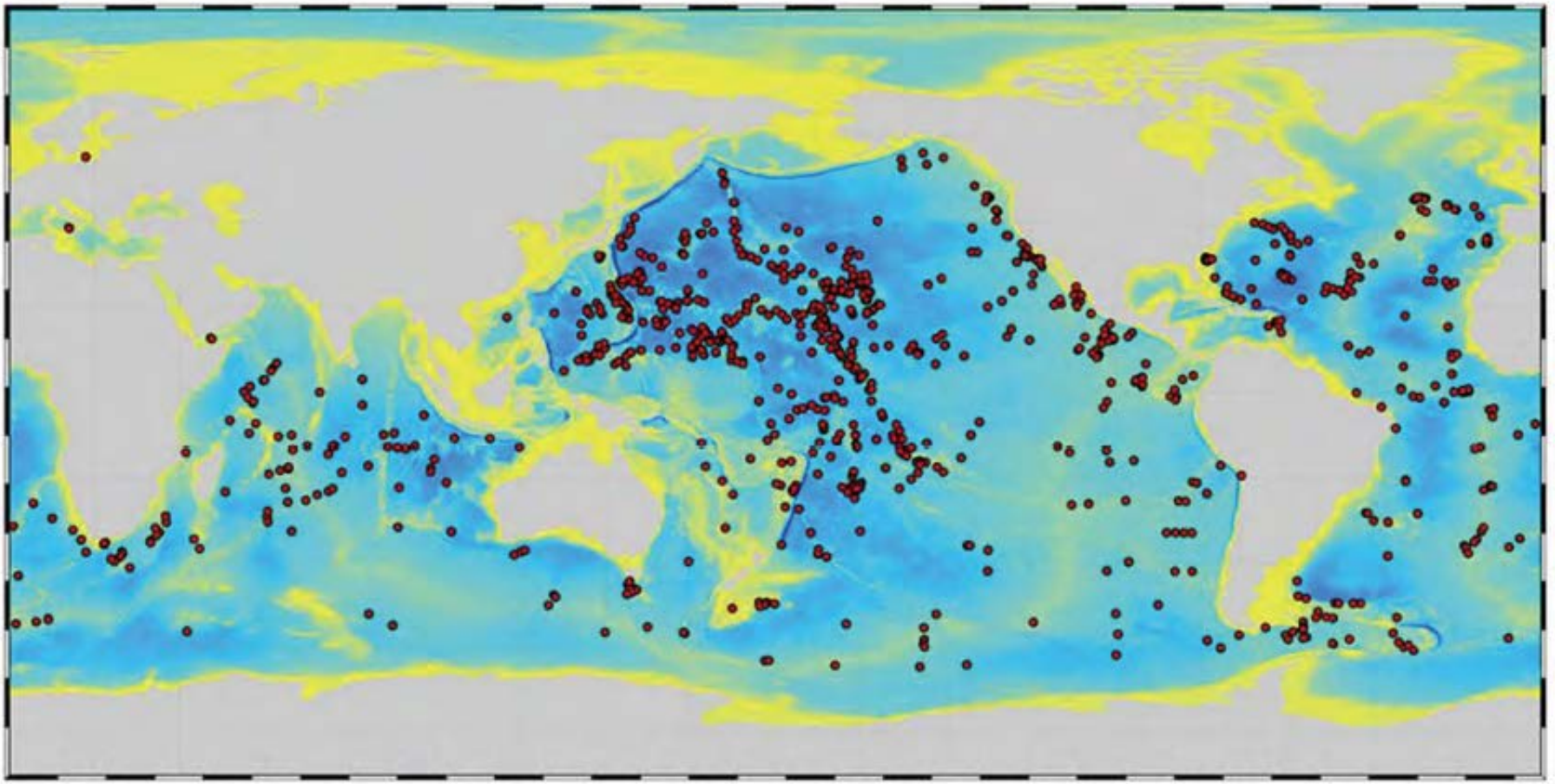
- **Main Elements**：Cobalt , Manganese, Iron, and so on. Cobalt is higher about 10 times than the same land ore.
- **Distribution Character**: Deep sea mounts with a water depth of 800-5000 meters. The crusts thickness generally is approximate 5-25cm.







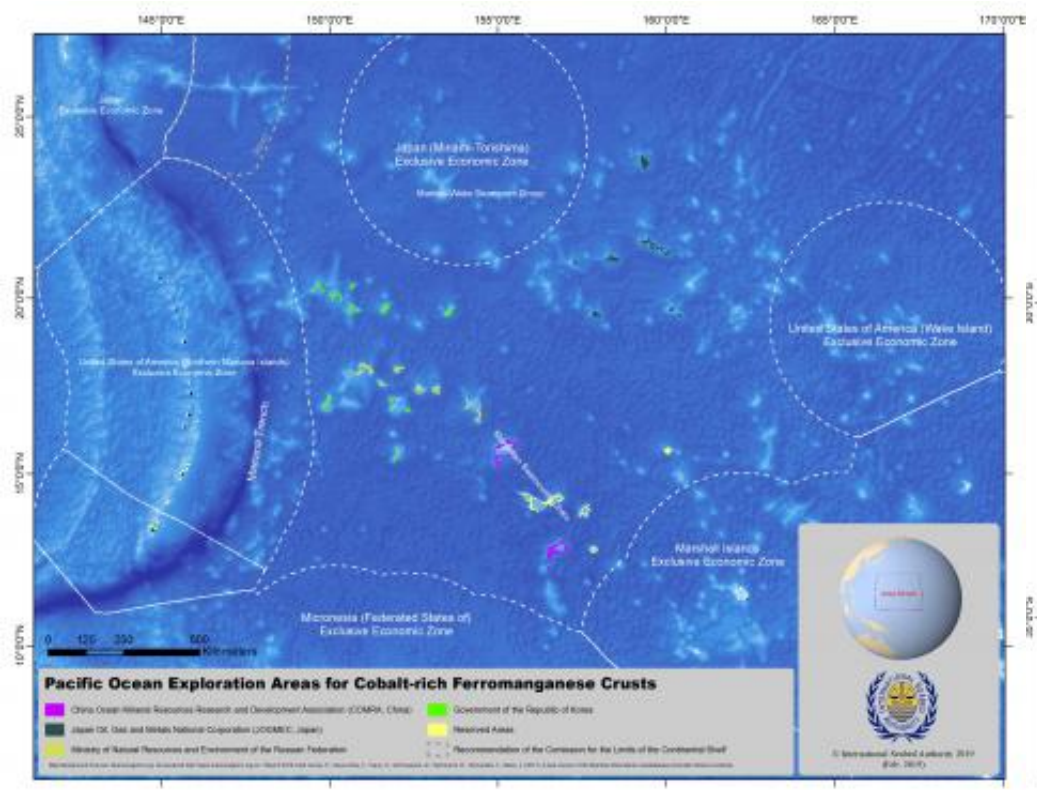
1. Deep Seabed Resources

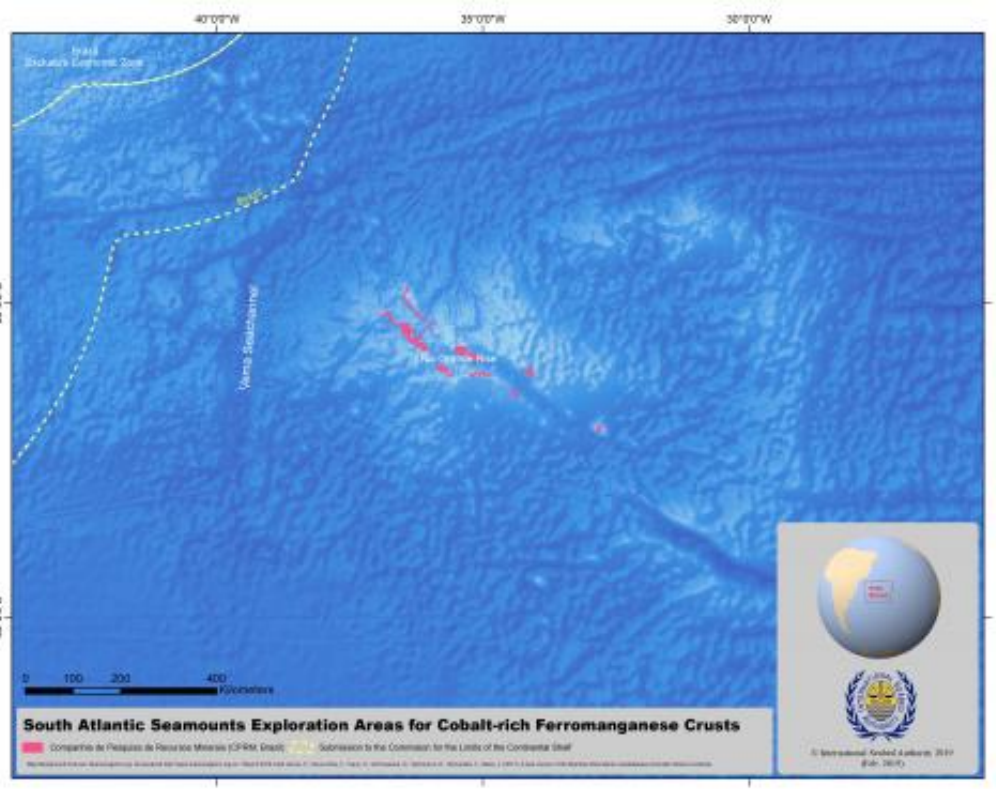


- **Distribution area:** Seamounts in Pacific, Atlantic, Indian Ocean .



1. Deep Seabed Resources





- 5 Contracts Areas before July 2019
- 4 in the Triangle Area, 1 in the South Atlantic

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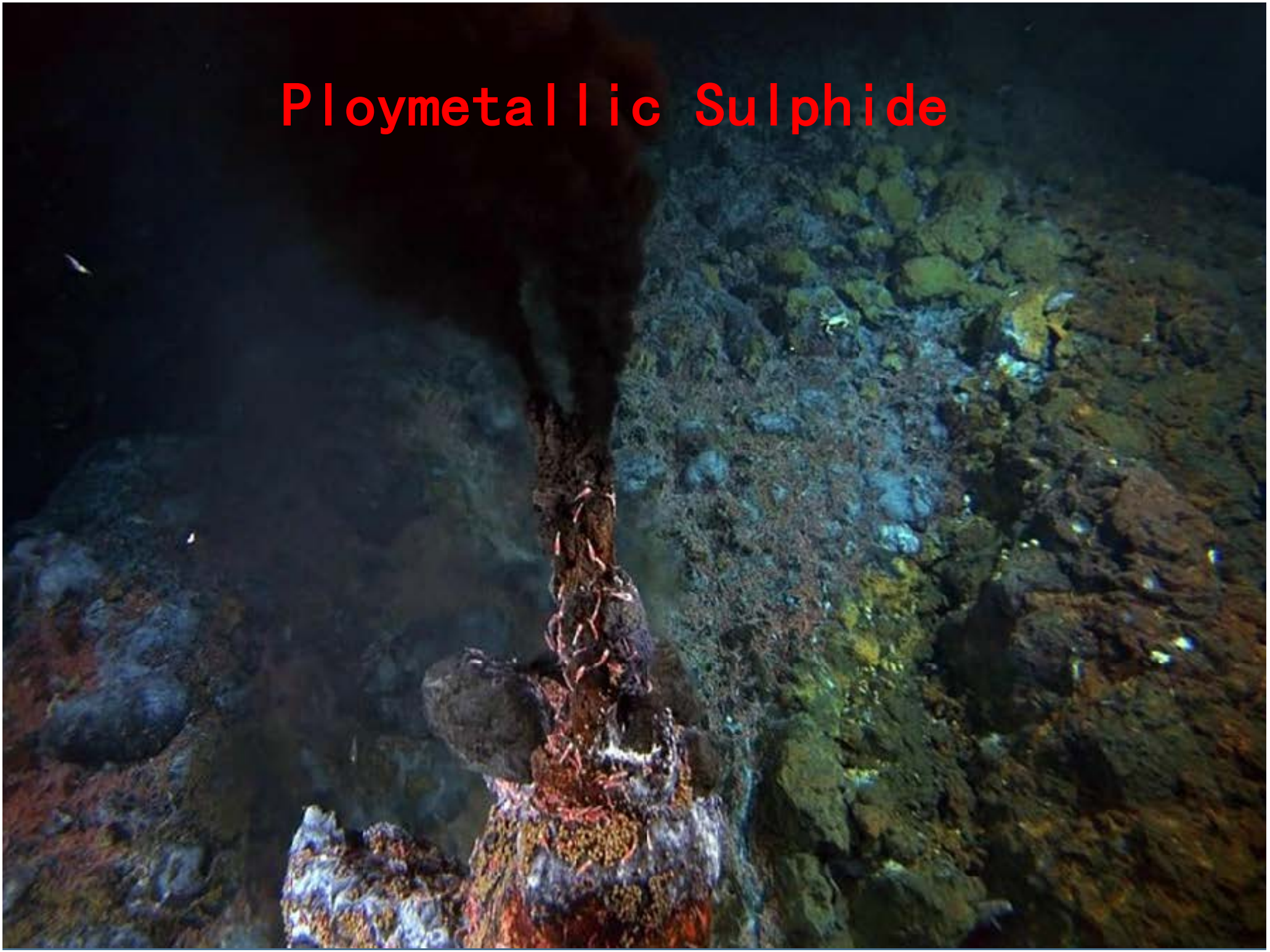
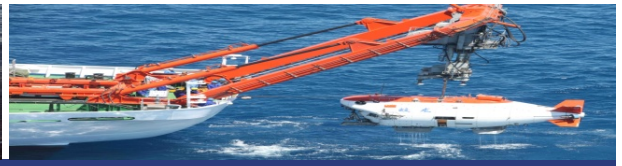

Ploymetallic Sulphide



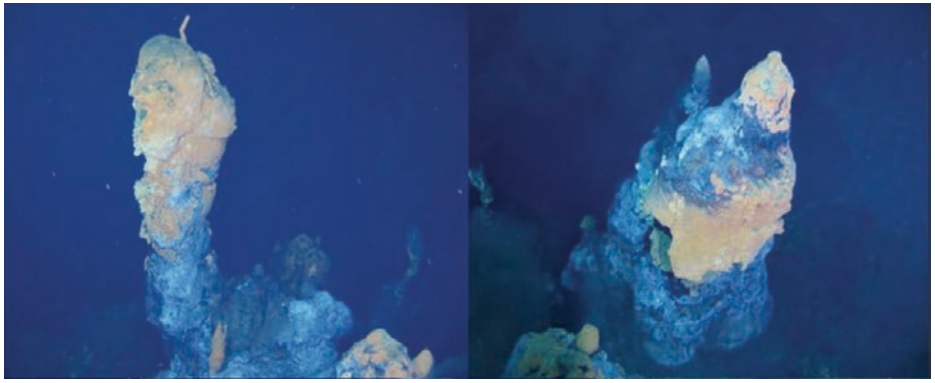
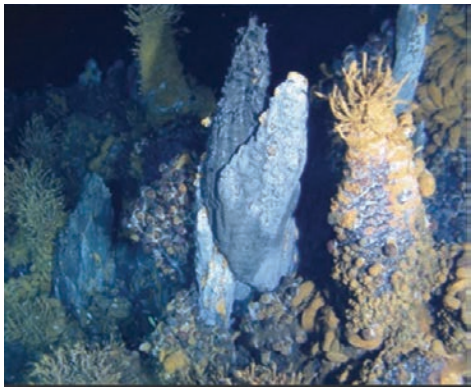
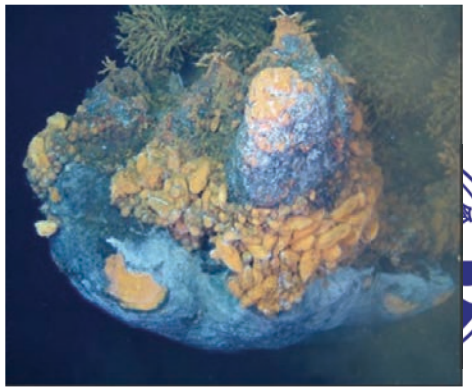


1. Deep Seabed Resources

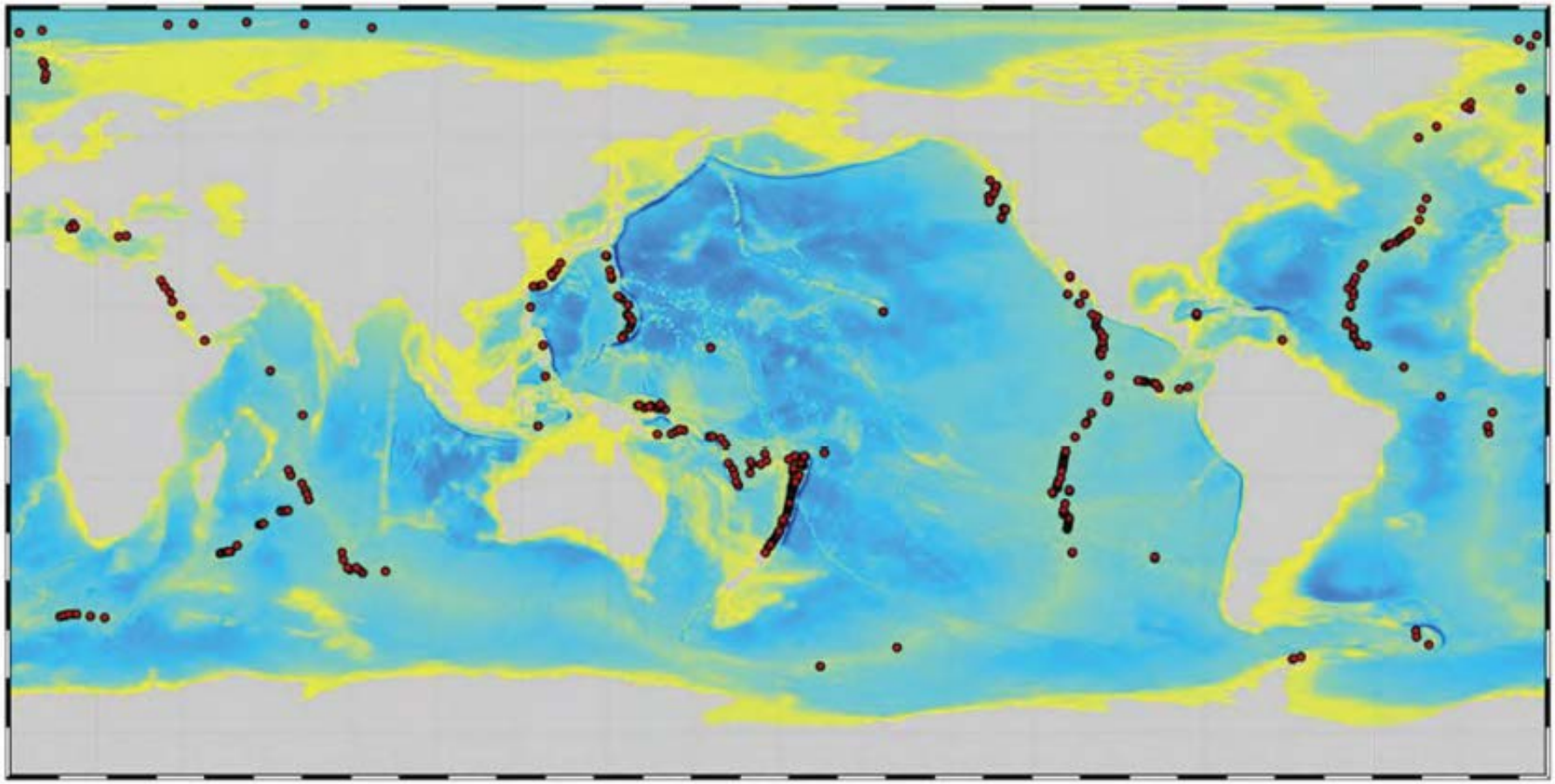
➢Ploymetallic Sulphides

- **Main Elements**：Copper, Zinc, Gold, Silver, Platinum, Lead, and so on. Sometimes, very higher precious metals than the land ore （Au4.8g/t）

- **Distribution Character**: In the form of hillocks, sediments, massive, with a water depth of 1000-4000 meters.





- **Distribution area:** Mid-ocean ridge; back-arc basin, island arc volcano, intraplate volcano. 187 active hydrothermal vents with massive sulphide have been discovered.

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1. Deep Seabed Resources

➢Ploymetallic Sulphides

CLASS	Inferred	Indicated
Ore (t)	1,300,000	870,000
Copper Grade	7.5%	6.8%
Copper (t)	97,500	59,160
Gold Grade (g/t)	7.2	4.8
Gold (OZ)	300,936	134,264
Project: Solwara 1	Location: EEZ of PNG	

(From： Environmental Impact Statement of solwara 1)

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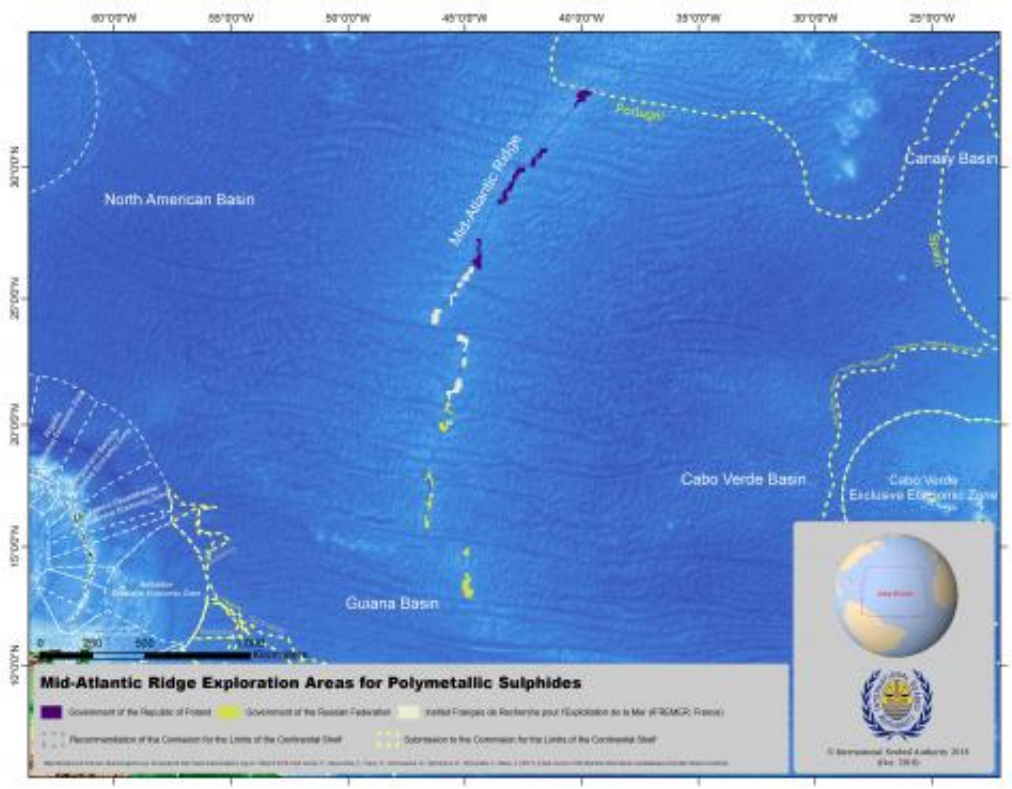
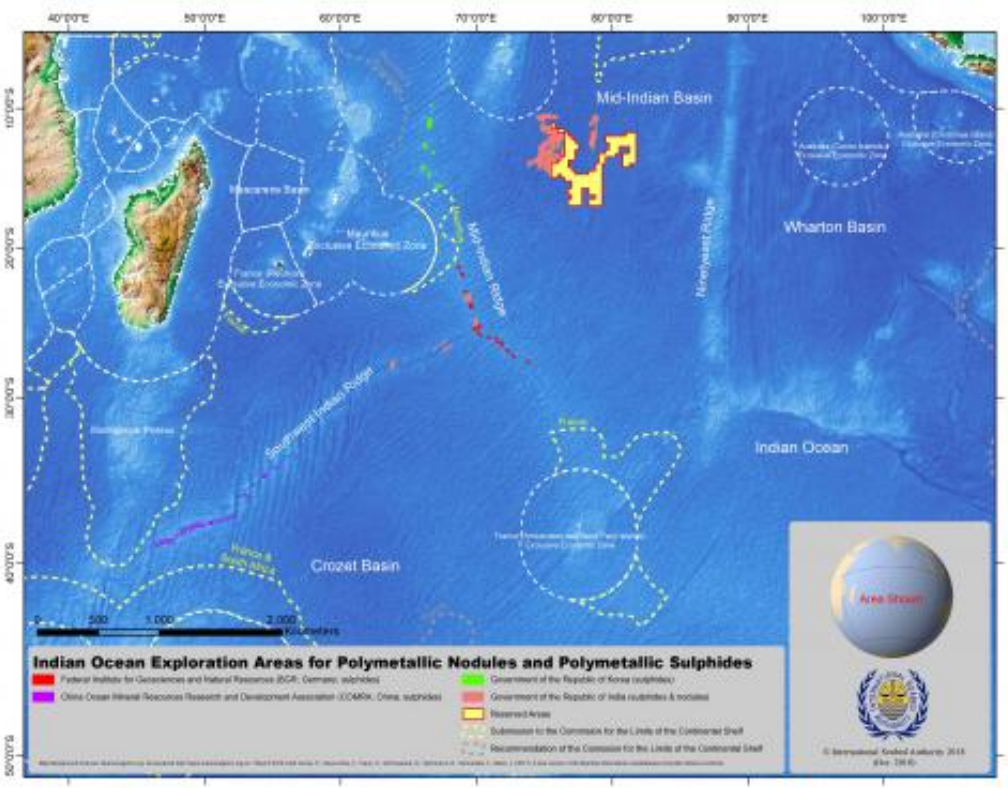
1. Deep Seabed Resources





- 7 Contracts Areas before July 2019
- 4 in the India Ocean, 3 in the Mid Atlantic

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OUTLINES

- **Deep Seabed Resources**
- **Industrial Application of Resources**
- **ISA –CHINA JTRC**



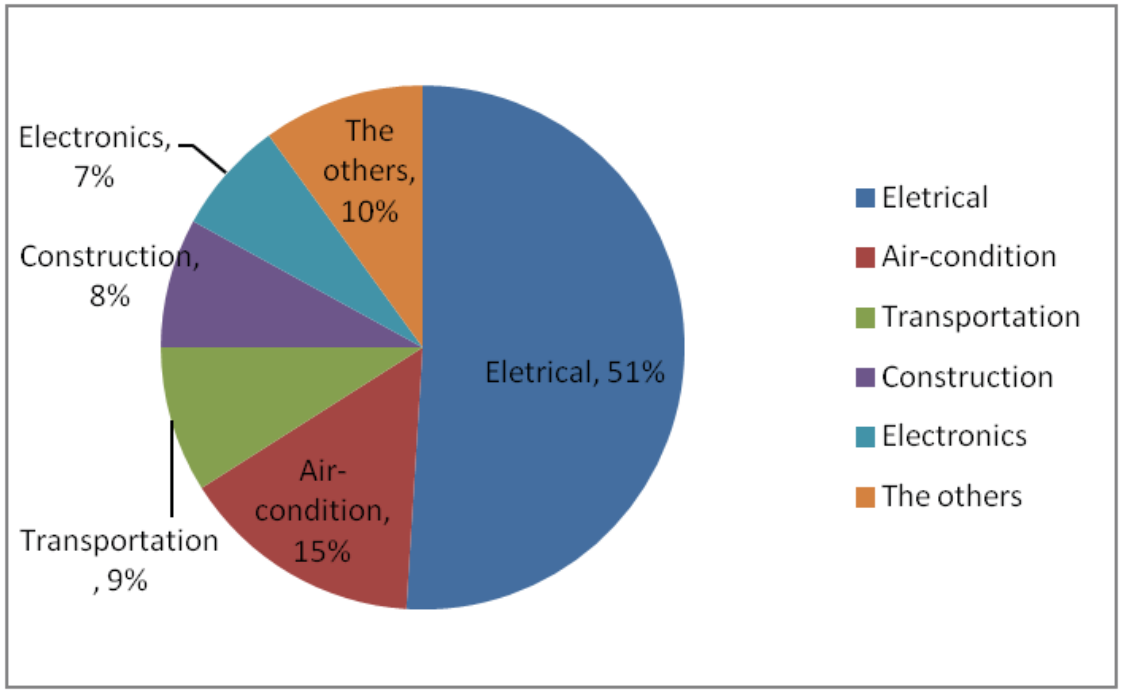
➢So far, deep seabed resources have not been directly used in industrial applications. Currently, industrial applications mainly focus on the metals which could extract from deep sea resources.

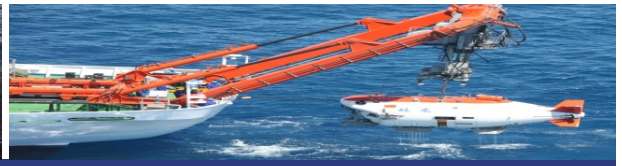
➢Copper , Nickel, Cobalt is widely applied in the modern industry.

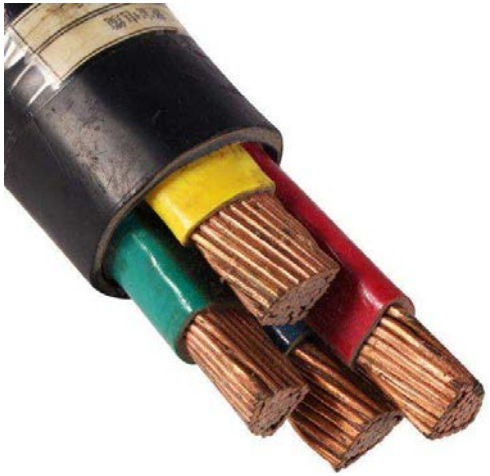


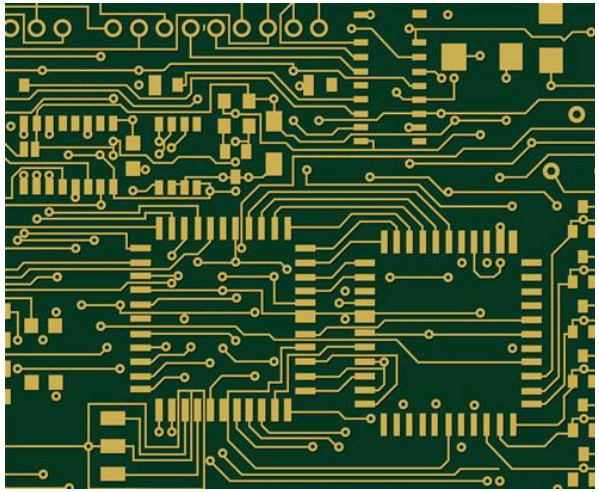
（1）Copper

Copper metal has good ductility, electrical and heat conductivity, widely used in electrical, manufacturing, construction and defense industries.
The figure is shown the copper consumption structure of china in 2016 .



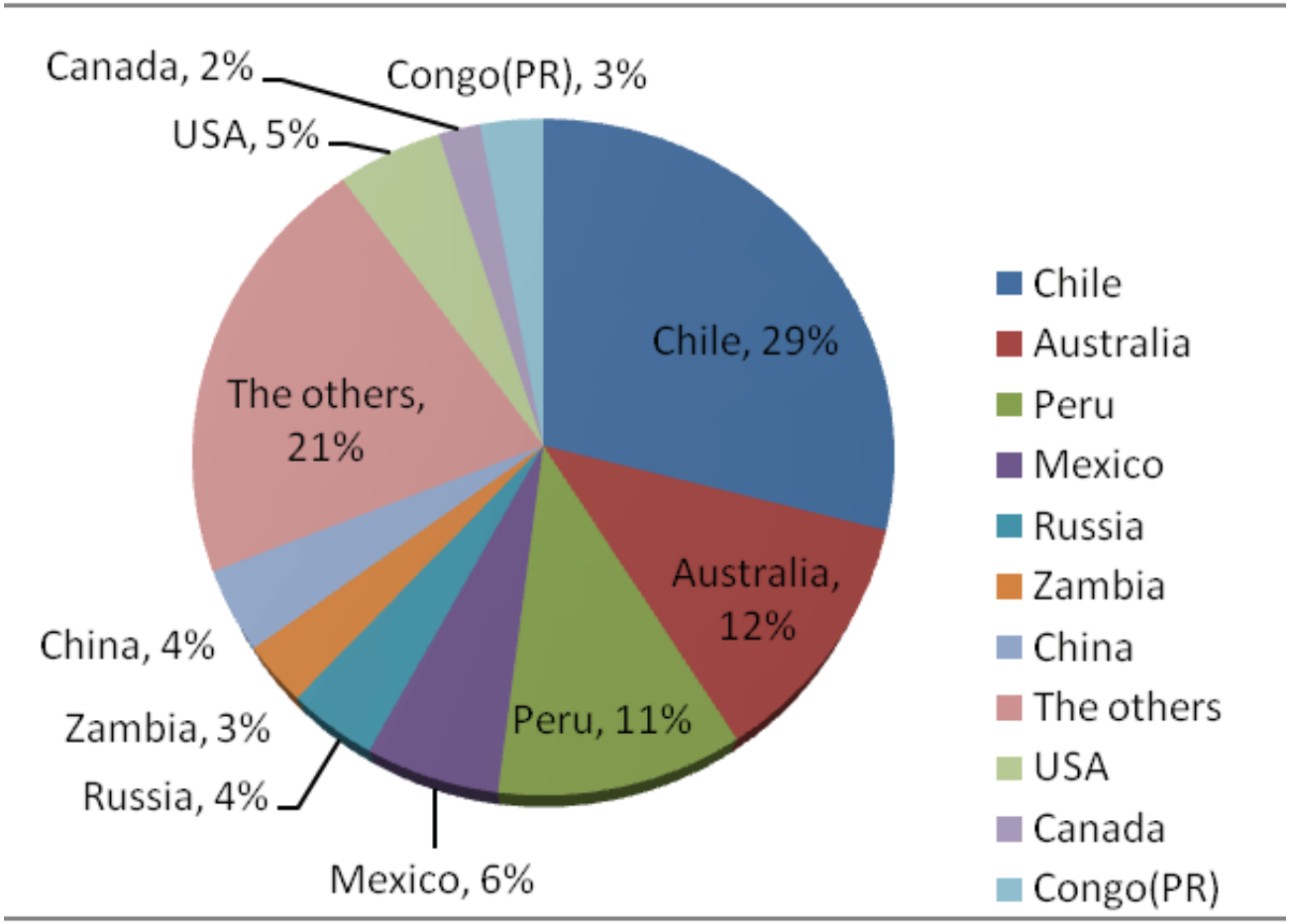






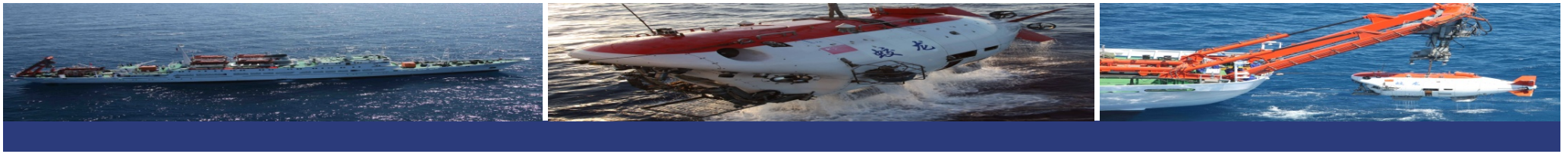


（1）Copper

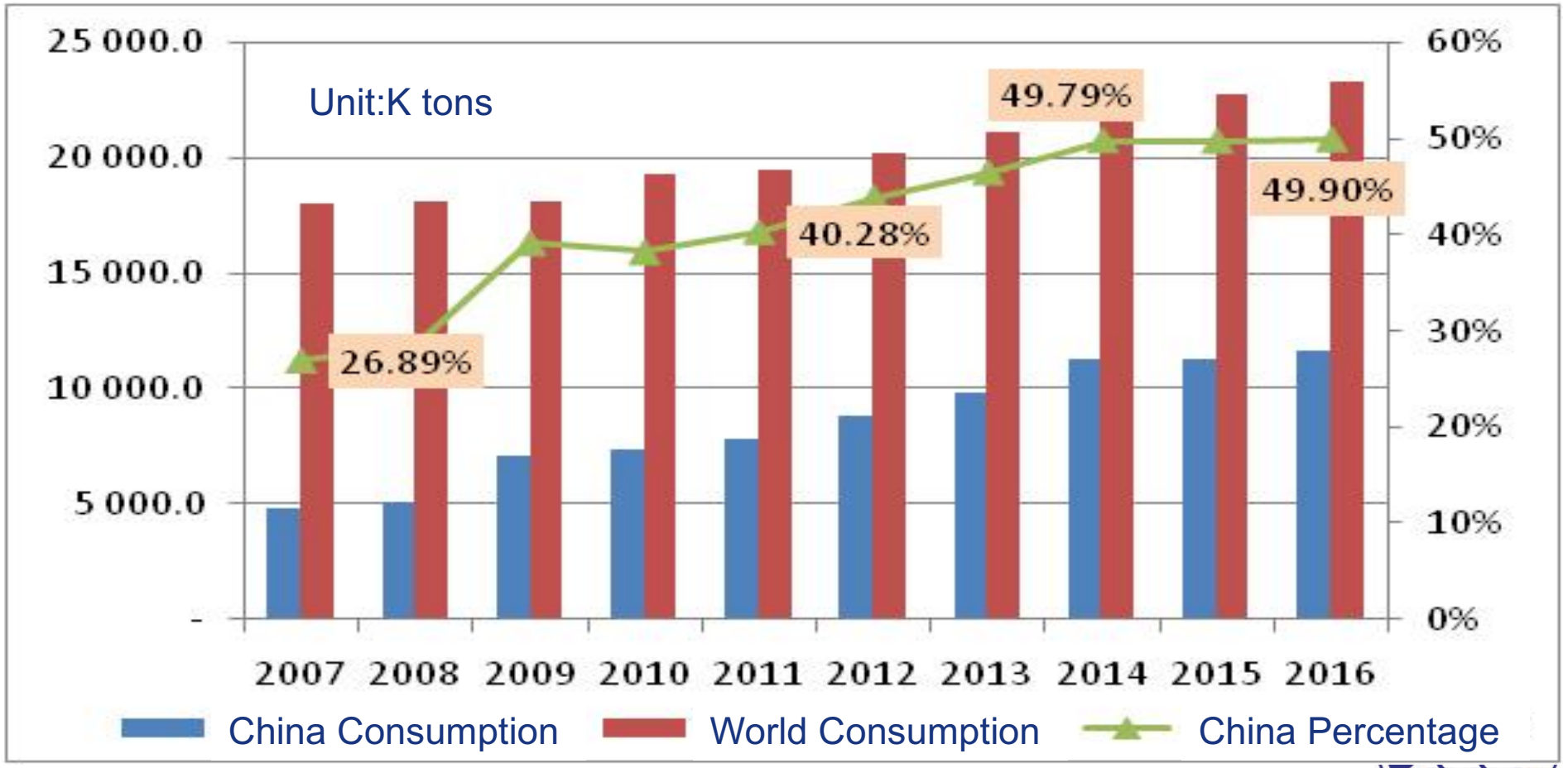


Global Land Copper Reserve(0.72B tons)

FROM： USGS 2017



（1）Copper



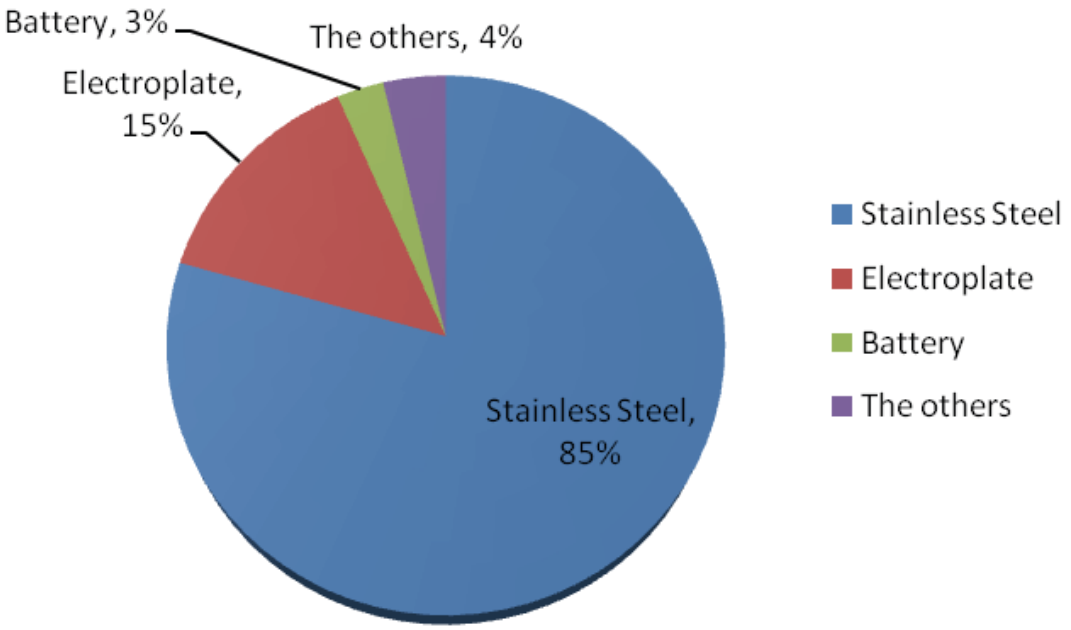
World Copper Concentrate Consumption

FROM： WBMS

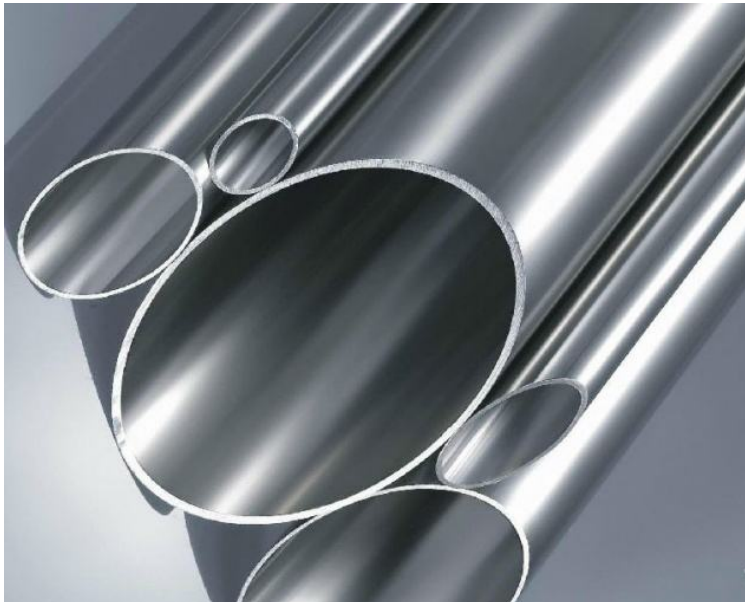


(2) Nickel

Nickel metal has excellent properties such as corrosion resistance, energy storage, wear resistance, high temperature resistance and high strength. It is a raw material for the manufacture of stainless steel, high nickel alloy steel and alloy structural steel. It is widely used in military manufacturing, machinery manufacturing, chemical industry, etc.

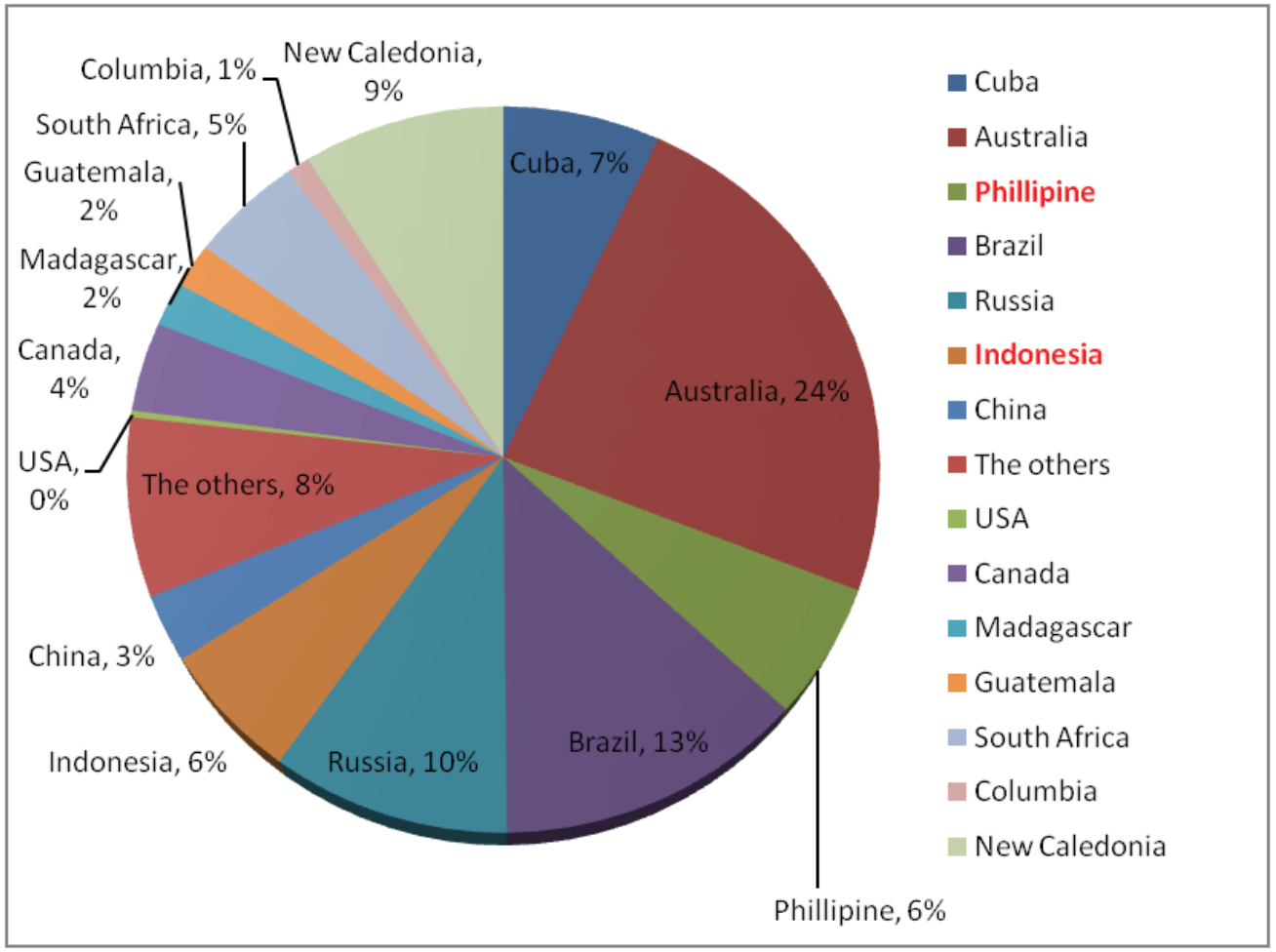



Ni-MH
AA 1300mAh 1.2V
Ni-MH
AA 1300mAh 1.2V
Ni-MH





(2) Nickel

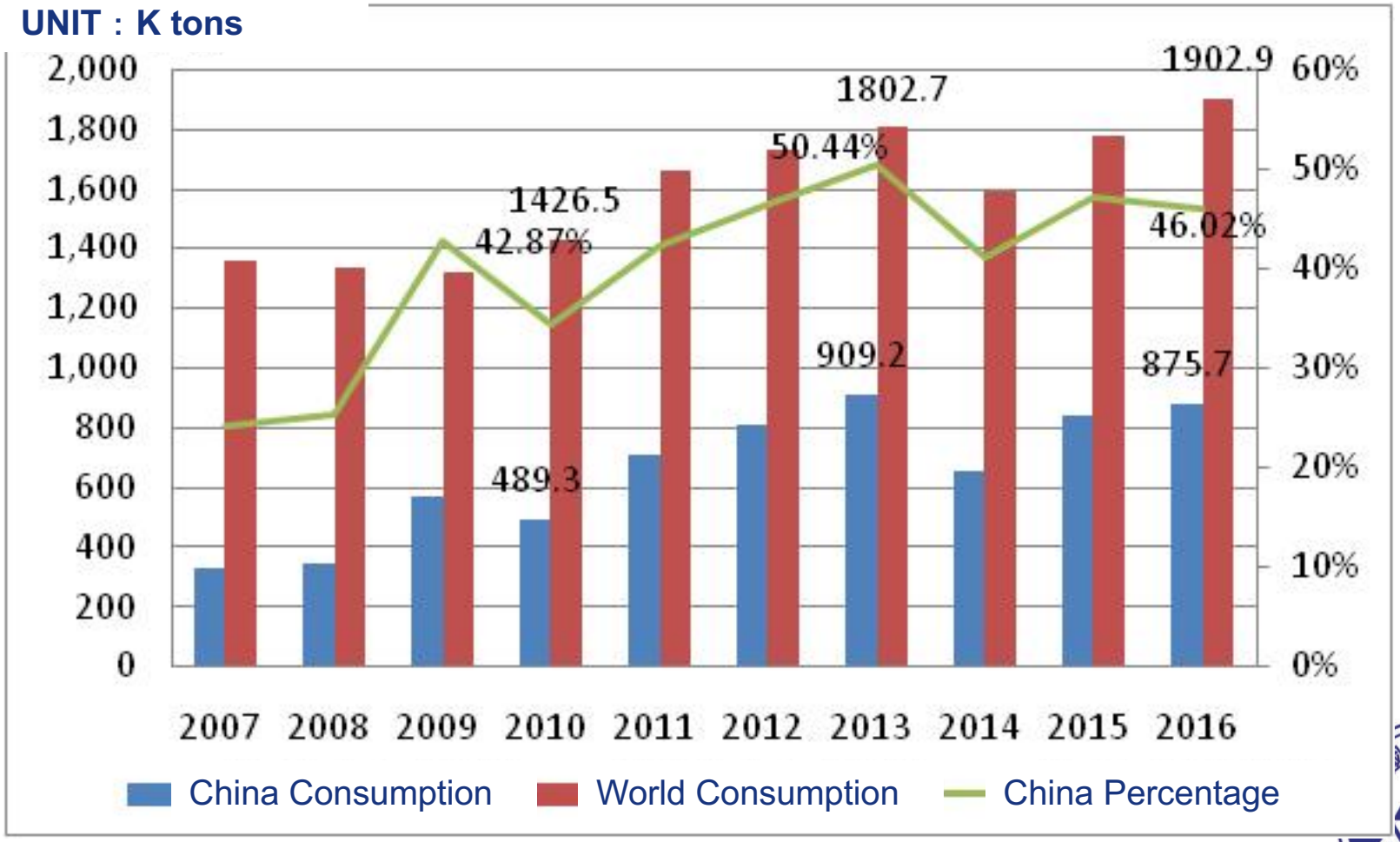


Global Land Nickel Reserve (78M tons)

FROM： USGS 2017



(2) Nickel



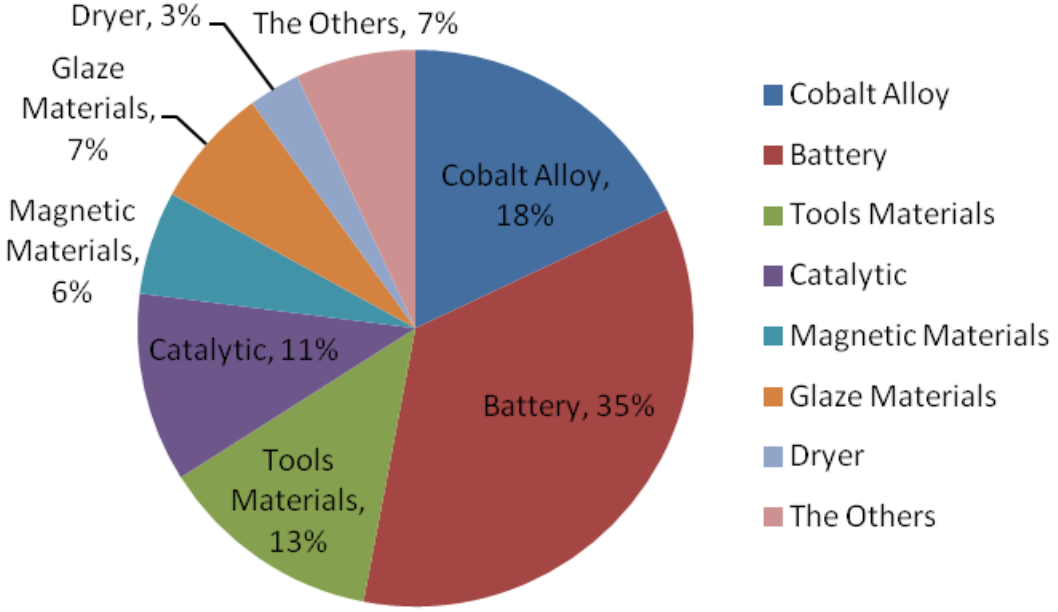
World Nickel Concentrate Consumption

FROM : WBMS



(3) Cobalt

Cobalt is an important material for the manufacture of heat-resistant alloys, hard alloys, anti-corrosion alloys and magnetic alloys. It is widely used in the aerospace, electrical, mechanical, chemical and ceramic industries. In recent years, cobalt chemicals, which are mainly battery materials, are the largest consumption areas of cobalt.



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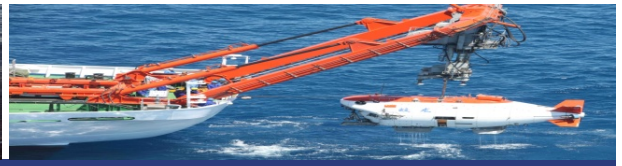

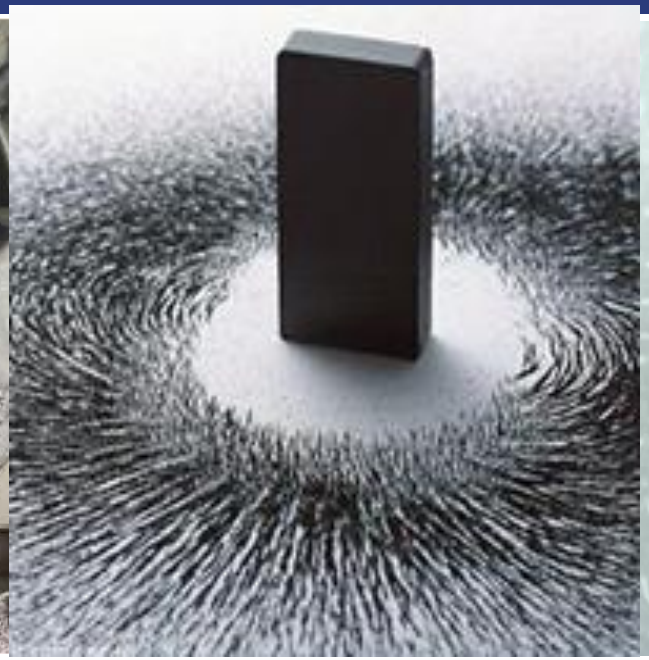


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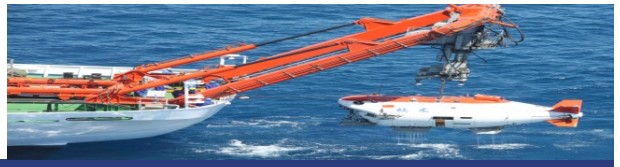


http://www.xuancaoyuan.com
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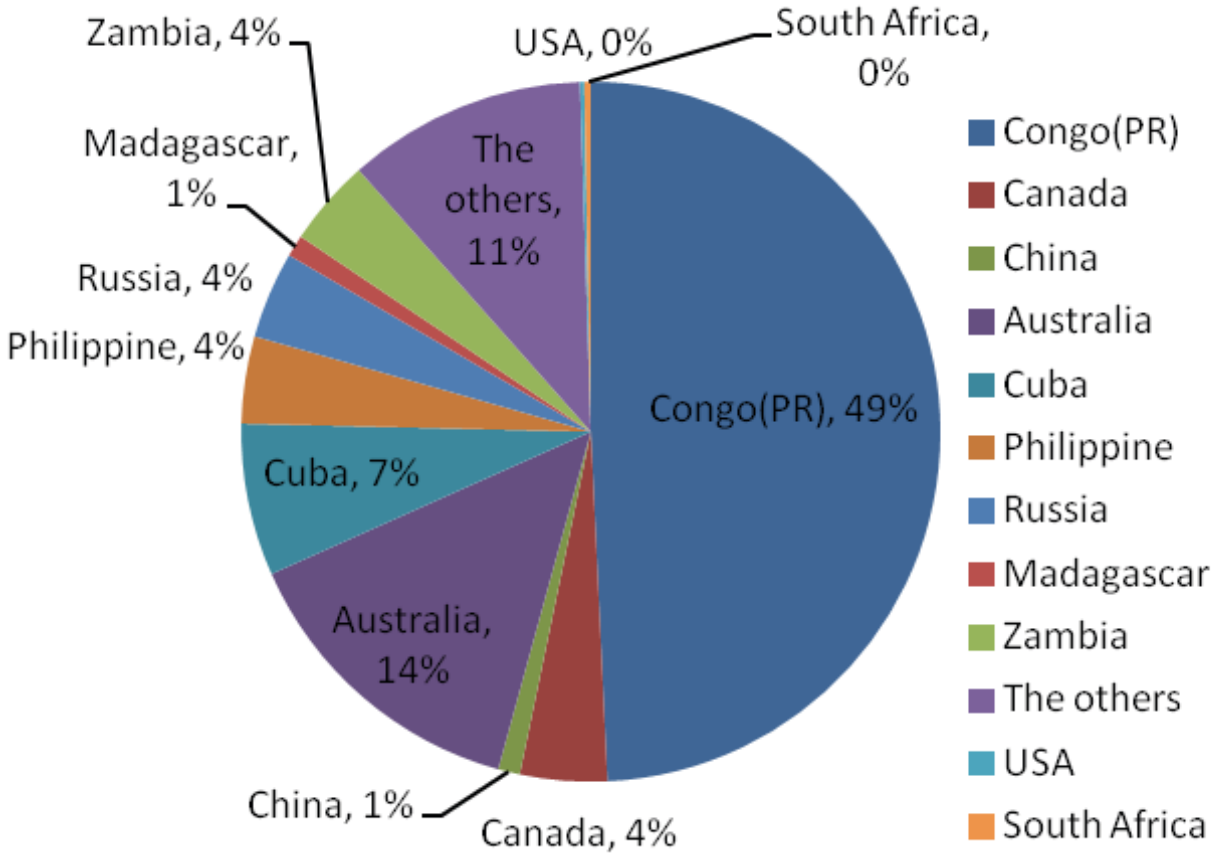
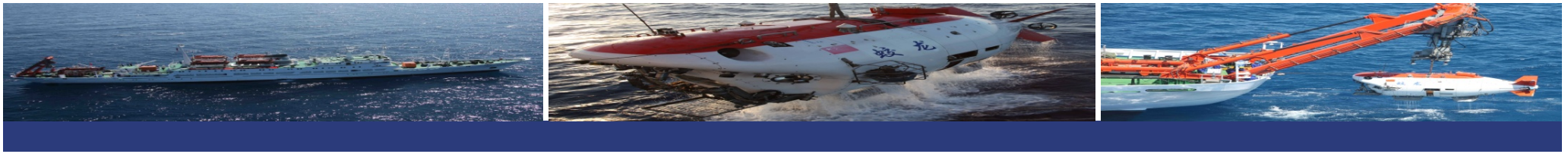
(3) Cobalt

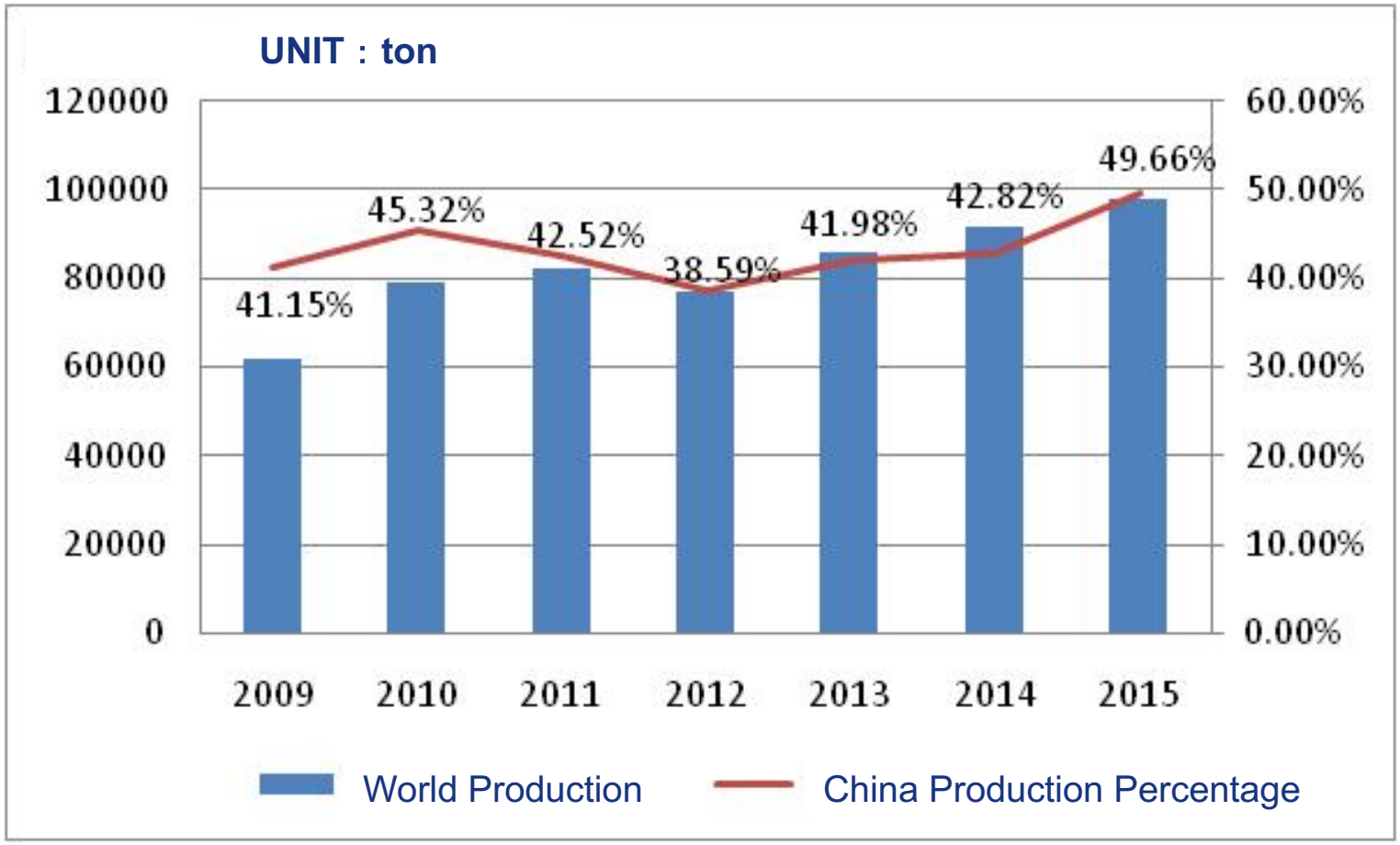


Global Land Cobalt Reserve(7M tons)

FROM： USGS 2017



(3) Cobalt



Global Land Cobalt Concentrate Production

FROM： USGS 2017



OUTLINES

- **Deep Seabed Resources**
- **Industrial Application of Resources**
- **ISA –CHINA JTRC**



3. ISA-CHINA JTRC

◆Background

- The strategic plan of the ISA for the five-year period 2019-2023 calls for all the stakeholders to play their active roles in the development, implementation and enforcement of rules and standards for activities in the Area to ensure that the activities are carried out for the benefit for mankind as a whole.
- ISA-China Joint Training and Research Center (JTRC) was correspondingly initiated by the SG of the ISA and Deputy Administrator of SOA of PRC in BEIJING in February 2018.
- The JTRC will contribute to pushing the strategic plan into practice under the coordination of the ISA. The MNR of PRC is willing to make great contribution to the capacity-building for the developing states through joint research and trainings.
- In 25th Session,2019, the draft MOU between the ISA and the MNR(SOA) of PRC Concerning the Establishment of JTRC has been approved by the Assembly of the ISA.



3. ISA-CHINA JTRC

◆The Missions of JTRC :

- Provision of training programs in marine science and technology as well as techniques for marine scientific research, which are designed to facilitate the full participation of developing States in activities in the Area;
- Conduct of collaborative research programs related to the latest developments and trends related to activities in the Area;
- Organization of conferences, seminars, workshops and symposia relating to marine scientific research in the Area and activities in the Area;
- Prompt dissemination of the results of marine scientific and technological research in readily available publications;
- Technical cooperation with other States, especially with the developing countries;
- Other functions as agreed by ISA and China.

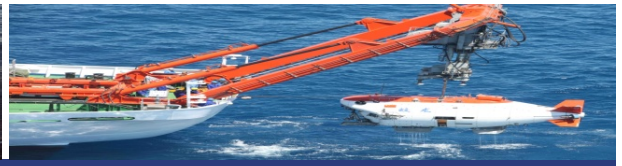


3. ISA-CHINA JTRC

◆The Capacities of JTRC :

- The JTRC will be established at the National Deep Sea Center (NDSC) located in Qingdao.The NDSC is a fully open service platform to promote development of oceanographic research, especially deep-sea exploration and exploitation through technology advancements and the effective operation and management of various ocean survey facilities, such as the JIAOLONG manned submersible, ROVs, AUVs and R/Vs.





3. ISA-CHINA JTRC

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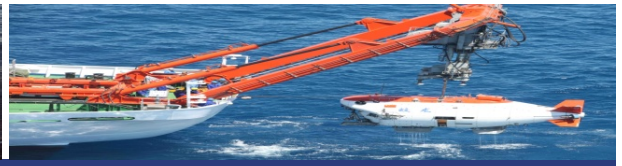
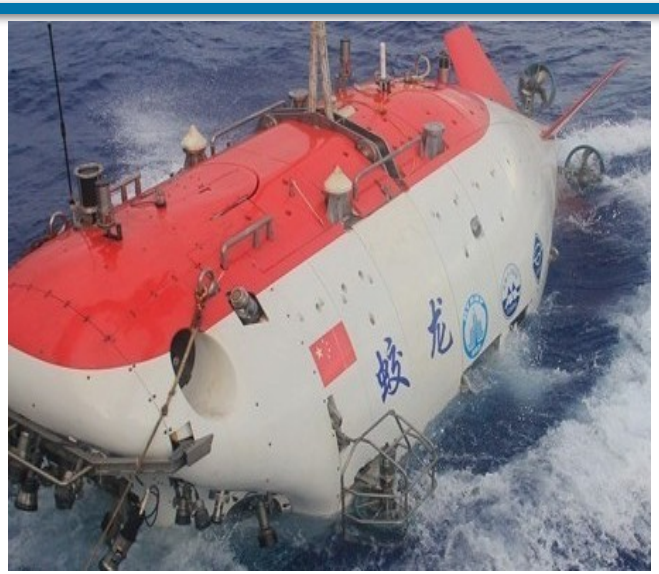
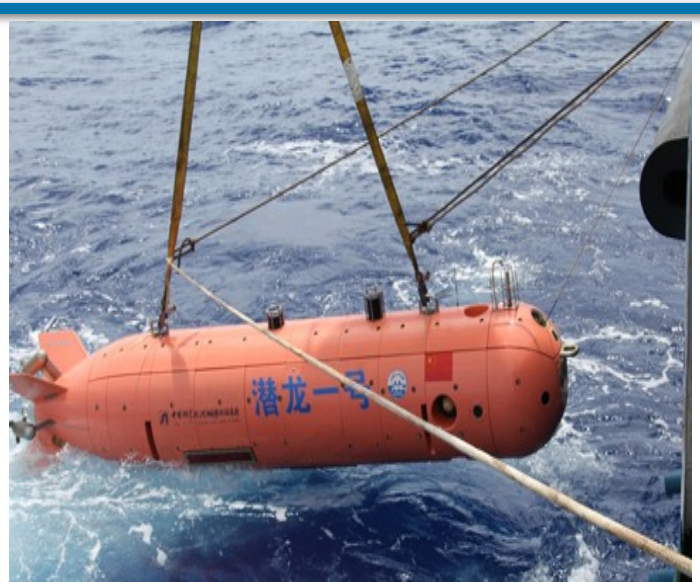


3. ISA-CHINA JTRC







NDSC‘s Facilities

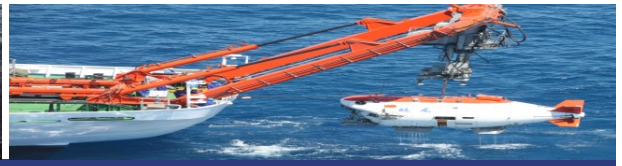


3. ISA-CHINA JTRC

◆ **Future Plan :**

- The JTRC's work is comprised of training and research components.
- The training component is a broad one and encompass 3 major themes relevant to the development of deep seabed activities: 1) Methodologies, 2) New Technologies and 3) Adaptive Legal Frameworks. For the first 3 years since 2020, the JTRC will receive up to 20 trainees coming from developing States each year.
- Research projects supported by the JTRC may include research relating to policies, technologies and best practice related to protection and preservation of the marine environment, etc. The JTRC will support 2 to 3 international cooperative research projects for each year in the first 3 years since 2020. These projects are fully open to researchers in the member States of the ISA.





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- The **JTRC sincerely welcomes** all experts and scholars from the world who are interested in the international seabed affairs to actively participate in the training and research work of this center. Qingdao welcomes everybody!

THANK YOU FOR ATTENTION!