China Geological Survey
Qingdao Institute of Marine Geology

MINUTE OF MEETING

BETWEEN
DEPARTMENT OF MINERAL RESOURCES
MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT
THE KINGDOM OF THAILAND
AND
QINGDAO INSTITUTE OF MARINE GEOLOGY
CHINA GEOLOGICAL SURVEY, MINISTRY OF NATURAL RESOURCES
PEOPLE'S REPUBLIC OF CHINA

TUSEDAY 16TH OCTOBER 2018
AT DMR, BANGKOK, THAILAND

I. INTRODUCTION

1. Pursuant to the visit of the QIMG Representatives to Thailand during 14 – 20 October 2018, the meeting between the Department of Mineral Resources (DMR), Ministry of Natural Resources and Environment, Thailand and Qingdao Institute of Marine Geology (QIMG), China Geological Survey, Ministry of Natural Resources, People's Republic of China, was held at DMR, Bangkok on Tuesday 16th October 2018, 09.30-16.30 hrs.

2. The DMR Representatives were led by Mr. Anukoon Wongyai, Director of Geotechnology Division. The QIMG representatives were led by Prof. Wen Zhenhe, Director of Marine Regional Geology Division. The List of Representatives of both sides appeared in **Annex I**.

3. The objectives of the meeting were to introduce the activities on geosciences issues of both organization and discuss on the new cooperative research project between DMR and QIMG. The Meeting Programme was shown in **Annex II**.

4. It is honored that Mr. Niwat Maneekhut, Deputy Director General of the DMR delivered welcome speech for this discussion. **Annex III**.

II. RECORDS OF MEETING

1. COASTAL AND MARINE ACTIVITIES IN THAILAND PRESENTATION
DMR Representative present a brief activities on coastal and marine geology in Thailand:
(1) Marine Geology Activities in the Thai Waters by Mr. Wichien Intasen
*Detailed document on the above matter was shown in **Annex IV***

2. COASTAL AND MARINE ACTIVITIES IN CHINA PRESENTATION
QIMG Representatives present a brief activities on coastal and marine geology in China:
(1) Introduction of Qingdao Institute of Marine Geology, China Geological Survey by Mr. Wang Zhongbo
(2) Marine Regional Geological Survey in China by Mr.Wen Zhenhe
(3) China-ASEAN Compilation of Marine Geoscience Map Series by Ms. Li Jie
*Detailed document on the above matter was shown in **Annex V**.*

3. THE NEW COOPERATIVE RESEARCH PROJECT BETWEEN QIMG AND DMR
DMR and QIMG representative discussed in more detail on the new initiative on cooperative research project entitled "The Cooperative Project of Marine Geoscience Maps

Compilation and Coastal Geohazards". The draft agreement on the said project was checked for clarification with some minor change in the draft. Finally, both sides agreed to follow-up after this meeting on;

a) QIMG will prepare a final drafting of Project Agreement of Technical collaboration and send to DMR for revising and comments.

b) Roadmap and Project Plan 2019-2021 shall be formulated by working group of the project after signing project agreement.

III. OTHER MATTERS

Both sides agreed that the Minute of Meeting should be prepared. The meeting was held and recorded in Bangkok, Thailand, on 16th October 2018.

For the Department of Mineral Resources

Ministry of Natural Resources and Environment
The Kingdom of Thailand

.....
(Mr. Anukoon Wongyai)
Director of Geotechnology Division

For Qingdao Institute of Marine Geology
China Geological Survey
Ministry of Natural Resources
People's Republic of China

.....
(Prof. Wen Zhenhe)
Director of Marine Regional Geology Division

Annex I

List of participants

Participants from Qingdao Institute of Marine Geology (QIMG)

1. Mr.Wen Zhenhe	Director of Marine Regional Geology Division
2. Mr. Wang Baojun	Professor
3. Mr. Guo Xingwei	Professor
4. Mr. Wang Zhongbo	Professor
5. Ms. Li Jie	Assistant Researcher

Participants from Department of Mineral Resources (DMR):

1. Mr. Niwat Maneekhut	Deputy Director-General
2. Mr. Naramase Teerarungsigul	Senior Expert (Mineral Resources Management)
3. Mr. Niran Chaimanee	Senior Expert (Geological and Geopark Management)
4. Mrs. Suree Teerarungsigul	Director of Environmental Geology Division
5. Mr. Anukoon Wongyai	Director of Geotechnology Division
6. Mr. Suvapak Imsamut	Director of Geological Resources Conservation and Management Division
7. Mr. Somboon Khositanont	Director of Information and Communication Technology Center
8. Mrs. Apsorn Sardsud	Senior Geologist
9. Mr. Wichien Intasen	Senior Geologist
10. Mr. Apichart Paiyarom	Senior Geologist
11. Mr. Somsak Wathanaprida	Senior Geologist
12. Mr. Sakda Khundee	Senior Geologist
13. Mr. Sathaporn Kavinate	Senior Geologist
14. Mr. Kitti Khaowiset	Senior Geologist
15. Ms. Janram Putthasem	Senior Plan and policy analyst
16. Ms. Siriporn Soongpankhao	Senior Geologist
17. Mr. Apichai Kanchanapant	Geologist
18. Ms.Wanpen Ouamjaibun	Geologist
19. Mr. Kavin Kedpiroij	Geologist
20. Mr. Chaiyasit Kruasorn	Geologist
21. Mr. Sumran praphat	Geologist
22. Mr. Pantarak Channarong	Geologist
23. Ms. Nouvarat Prinpreecha	Geologist
24. Ms. Sirirat Pulkasem	Geologist
25. Ms. Waraporn Jitsuwan	Mineral Resources Technical Officer
26. Mrs. Jaripaporn Chailertwanitkul	Plan and Policy Analyst
27. Ms. Prasopsook Sritangwong	Geologist
28. Ms. Nipaporn Hongsabal	Geologist

Annex II

ORDER OF THE DAY

for the meeting between

Department of Mineral Resources (DMR), Thailand and

Qingdao Institute of Marine Geology (QIMG), China

Time: Tuesday 16 October, 2018, 9.00-16.30
Venue: DMR Meeting Room, 1st Floor

Time	Presenter	Program
09.00 – 09.30	Representative from DMR and QIMG	- Registration
9.30-10.00	Representative from DMR and QIMG	Opening Ceremony, present a token of appreciation, Group photo
10.00-12.00	DMR/QIMG	- Introduction of participants from DMR - Introduction of participants from QIMG - DMR presentation: background and project about marine geology - QIMG presentation: background and project about marine geology
10.15-10.30		Coffee break (serve in the meeting room)
12.00-13.00		Lunch
13.00-14.30	DMR/QIMG	DMR-QIMG Project discussion - Work plan - project's agreement
14.30-14.45		Coffee break (serve in the meeting room)
14.30-15.30	DMR/QIMG	Plan for the investigation in Thailand - Investigation route for this visit
15.30-16.30	DMR/QIMG	Sign MOM
16.30		End of the Meeting

Annex III

Welcome Speech

Mr. Niwat Maneekhut,
Deputy Director-General
Department of Mineral Resources, Thailand

At the DMR-QIMG Meeting
16th October 2018, Meeting Room 1, DMR, Bangkok, Thailand

- Prof. Wen Zhenhe, Director of Marine Regional Geology Division of Qingdao Institute of Marine Geology
- Prof. Wang Baojun
- Prof. Gao Xingwei
- Prof. Wang Zhongbo
- Ms. Li Jie

Distinguish Delegates, Ladies and Gentlemen,
หนีห่าว, Good Morning,

On behalf of Department of Mineral Resources, Minister of Natural Resources and Environment, I would like to take this opportunity to sincerely welcome all delegation from Qingdao Institute of Marine Geology (QIMG) for visiting DMR. We all know that QIMG has been a professional institute for marine geological survey and research for very long time. The Thai delegation also reported their visit to Qingdao on June this year that QIMG would like to jointly cooperate with DMR in many aspects. I thank you all delegation and welcome to the DMR-QIMG meeting.

I do hope that our meeting will have an intensive discussion regarding the draft project agreement with a fruitful result. I was inform that you will have a change to visit the coastal area of Eastern Thailand which currently assign by the government as the new economic corridor of the country. My staff may explain to you in more detail as the last chapter of the meeting.

A part for the meeting please be informed that Thailand still have many thing to do and visit. Bangkok can offer you both modern life and old culture since it was established as the capital of Thailand more than two hundred years ago. I wish that you will enjoy while you stay in Thailand.

Lastly, I do hope that you will come to Thailand and explore the await excitement in the near future and thank you for joining us.

Thank you very much.

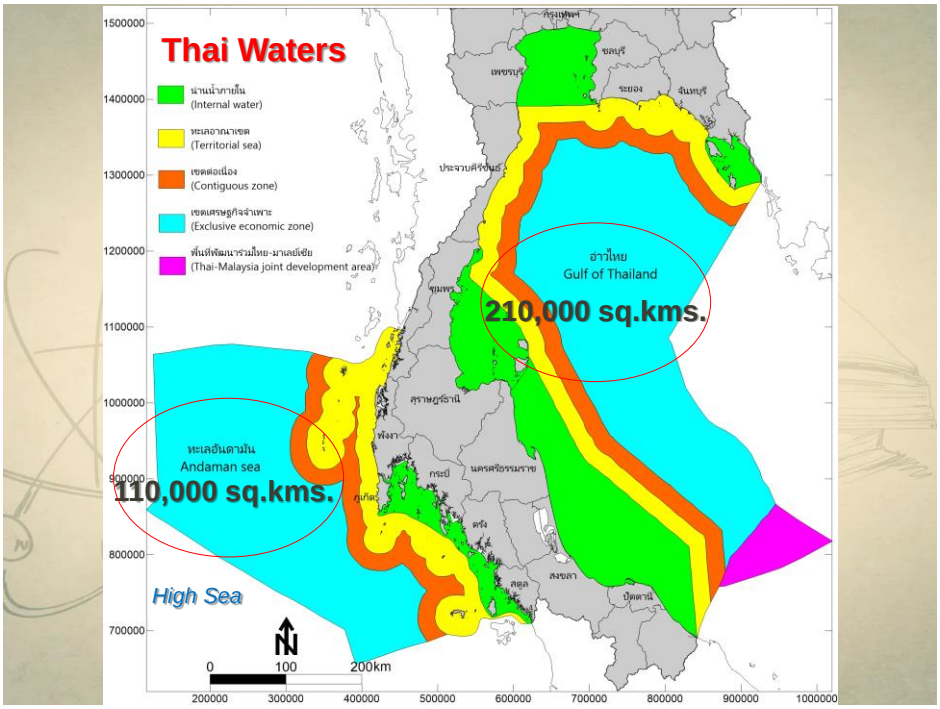
ขอบคุณครับ

ANNEX IV

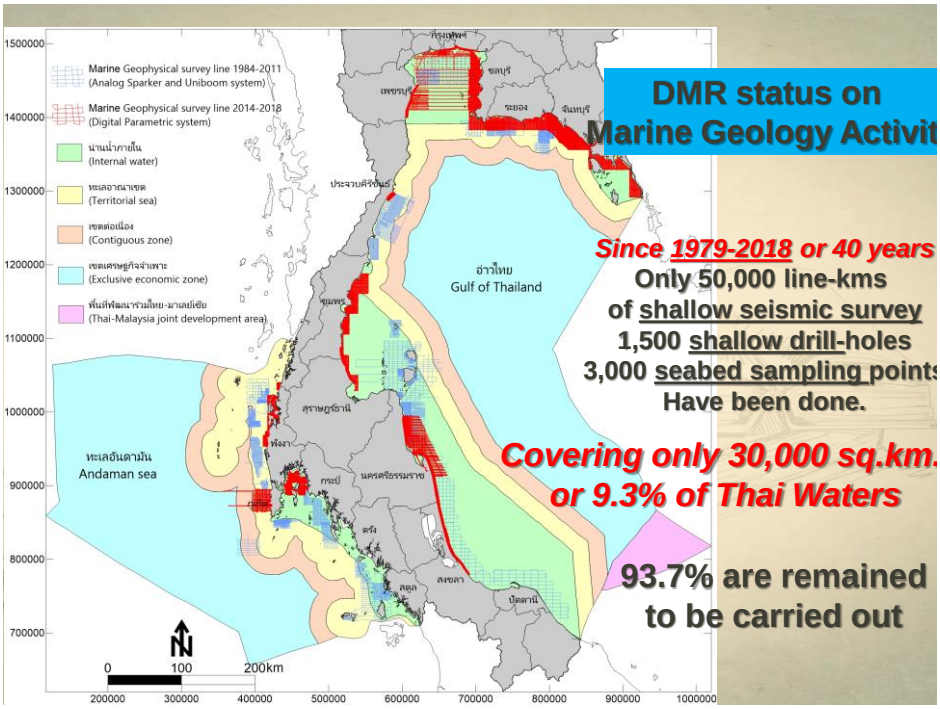
MARINE GOLOGY ACTIVITIES IN THE THAI WATERS

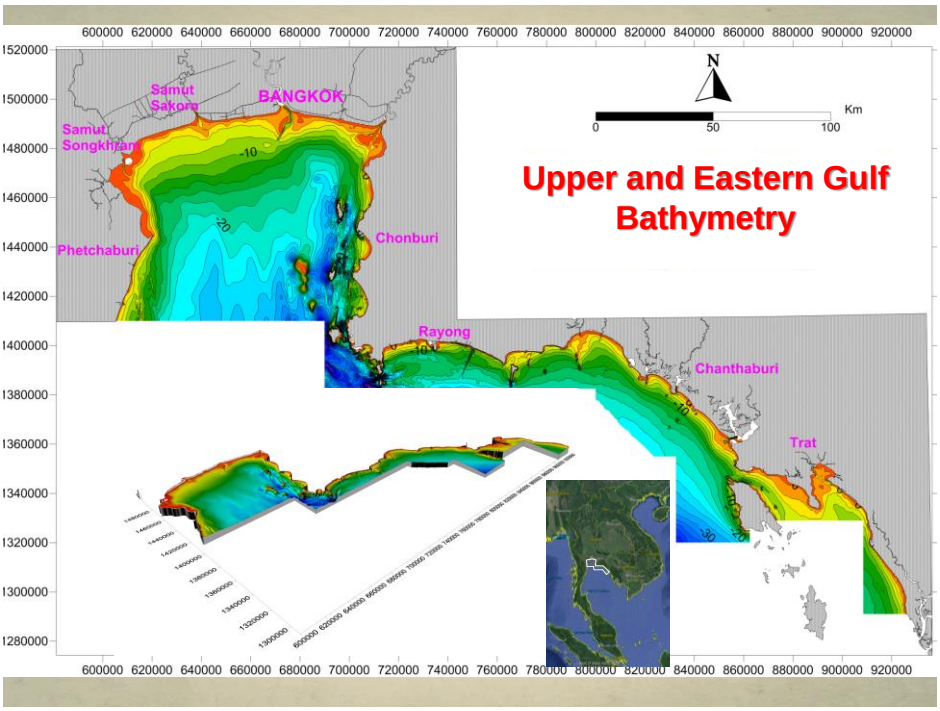
Main CONTENTS

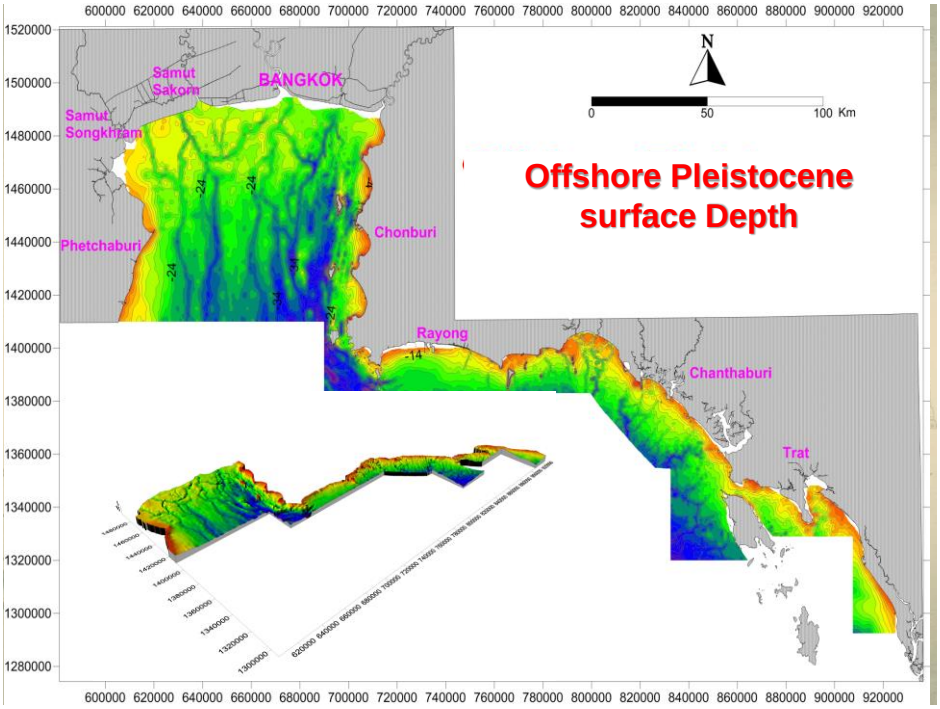
1. Marine Geology survey and mapping, done by DMR
2. Marine Geology survey, mapping, and compilation, done by other agencies, e.g. CCOP an
3. Marine Geology survey and mapping, done by DMCR and First Institute of Oceanography (FIO), China
4. Comparison Status of QIMG vs DMR on Marine Geology W

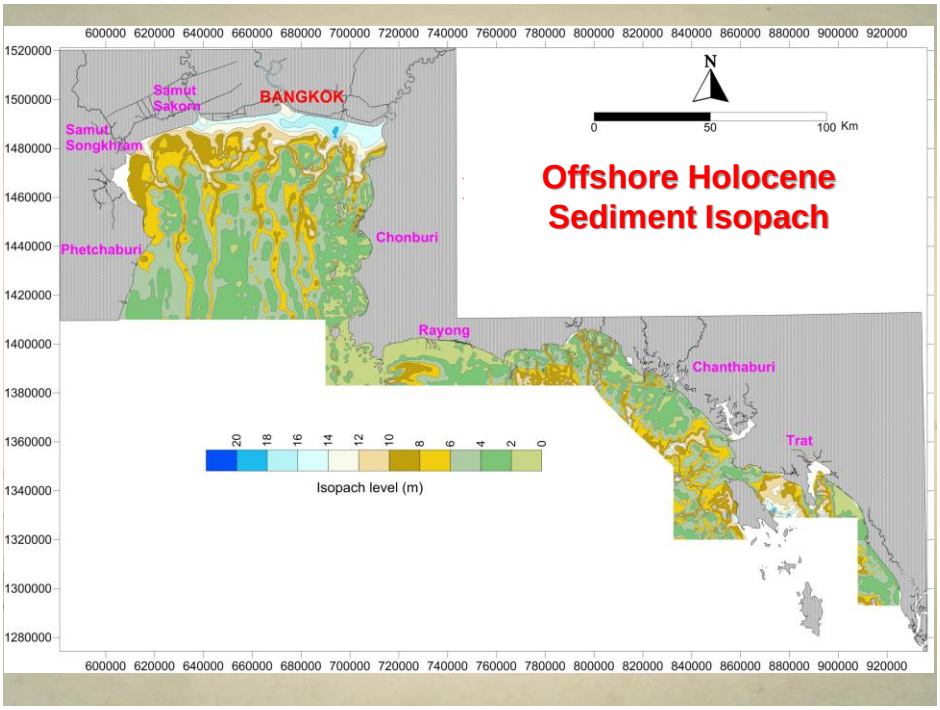


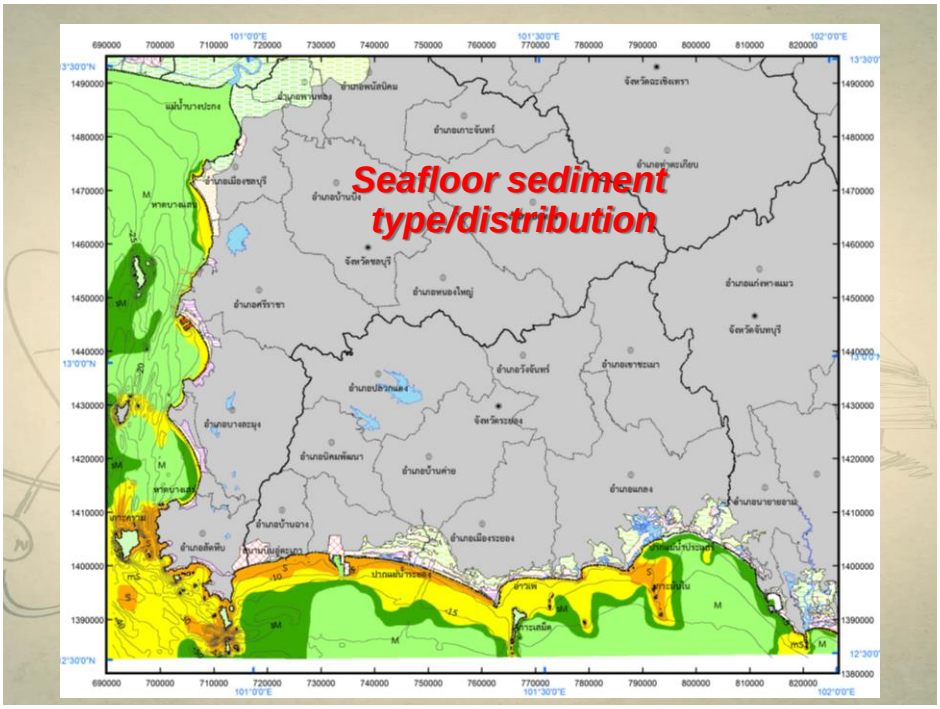
Marine Geology survey and mapping, done by DM

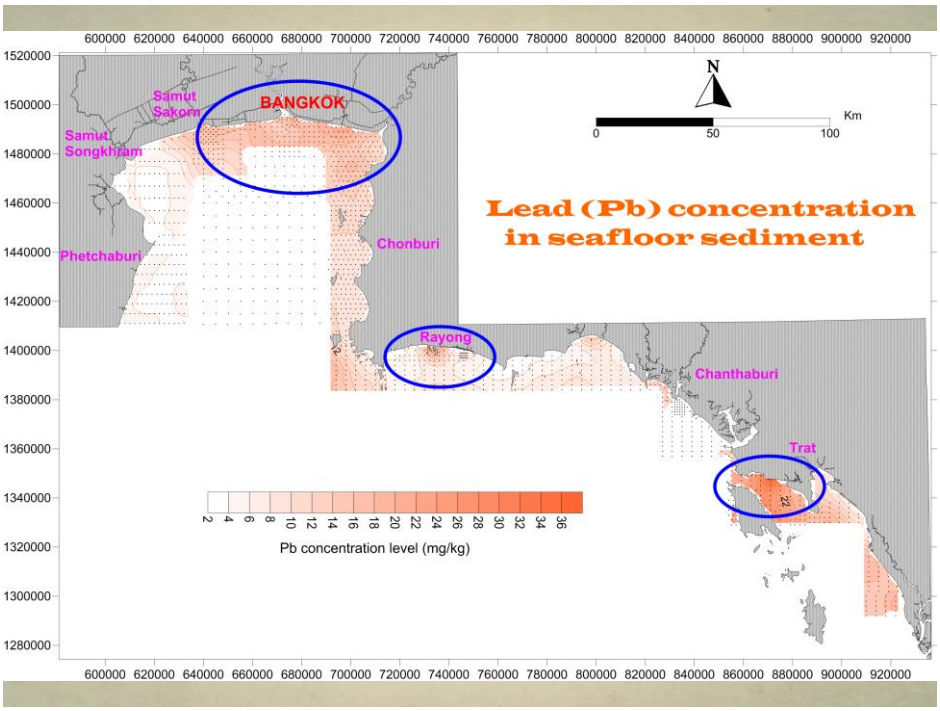

Marine Geophysical survey line 1984-2011
(Analog Sparker and Uniboom system)
Marine Geophysical survey line 2014-2018
(Digital Parametric system)
น่านน้ำภายใน
(Internal water)
ทะเลอาณาเขต
(Territorial sea)
เขตต่อเนื่อง
(Contiguous zone)
เขตเศรษฐกิจจำเพาะ
(Exclusive economic zone)
พื้นที่พัฒนาร่วมไทย-มาเลย์เซีย
(Thai-Malaysia joint development area)
อ่าวไทย
Gulf of Thailand
ทะเลอันดามัน
Andaman sea
0 100 200km
DMR status on
Marine Geology Activit
Since 1979-2018 or 40 years
Only 50,000 line-kms
of shallow seismic survey
1,500 shallow drill-holes
3,000 seabed sampling points
Have been done.
Covering only 30,000 sq.km.
or 9.3% of Thai Waters
93.7% are remained
to be carried out

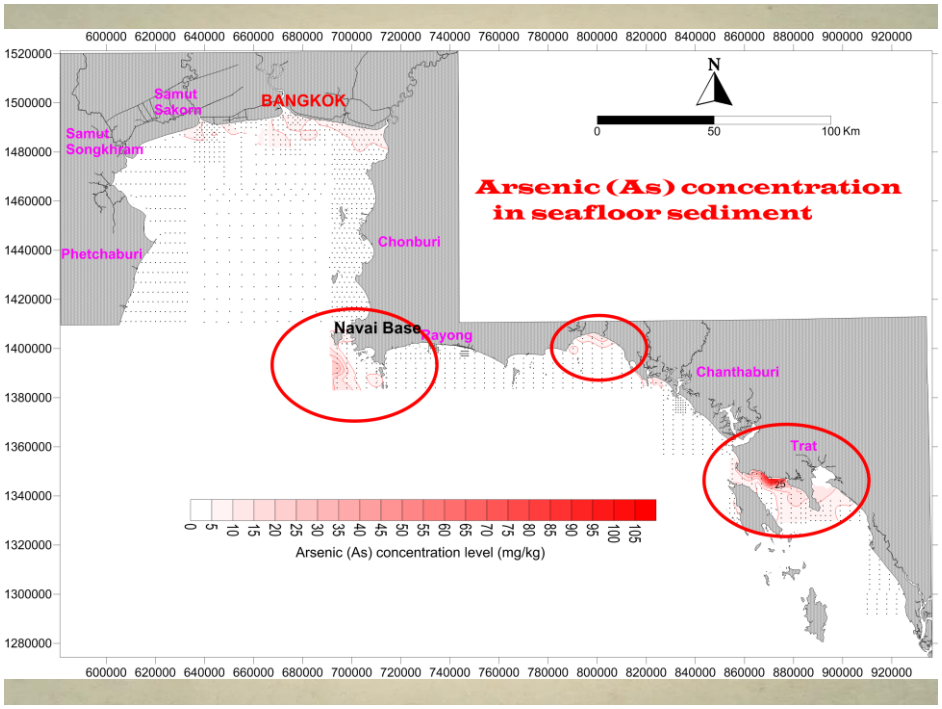

Samut Sakorn
BANGKOK
Samut Songkhram
Phetchaburi
Chonburi
Rayong
Chanthaburi
Trat
-10
-20
-30
N
0 50 100 Km
Upper and Eastern Gulf
Bathymetry

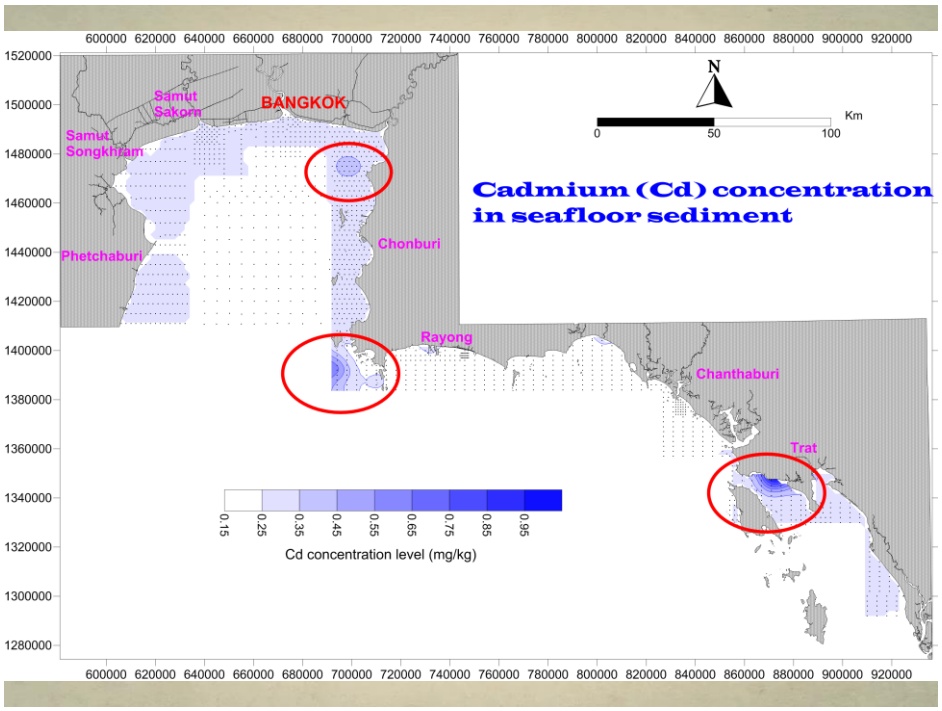

Samut Sakorn
BANGKOK
Samut Songkhram
Phetchaburi
Chonburi
Rayong
Chanthaburi
Trat
N
0
50
100 Km
Offshore Pleistocene surface Depth

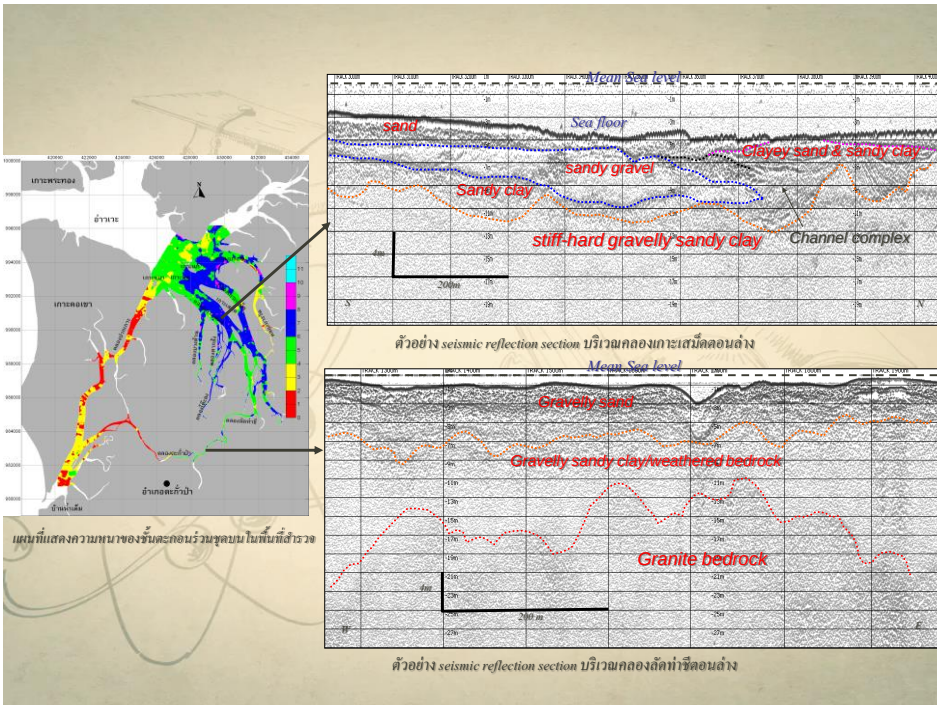

Samut Sakorn
BANGKOK
Samut Songkhram
Phetchaburi
Chonburi
Rayong
Chanthaburi
Trat
N
0
50
100 Km
Offshore Holocene Sediment Isopach
20 18 16 14 12 10 8 6 4 2 0
Isopach level (m)


Seafloor sediment
type/distribution


Samut
Sakorn
BANGKOK
Samut
Songkhram
Phetchaburi
Chonburi
Rayong
Chanthaburi
Trat
N
Km
0
50
100
Lead (Pb) concentration
in seafloor sediment
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
Pb concentration level (mg/kg)


600000 620000 640000 660000 680000 700000 720000 740000 760000 780000 800000 820000 840000 860000 880000 900000 920000
1520000
1500000
1480000
1460000
1440000
1420000
1400000
1380000
1360000
1340000
1320000
1300000
1280000
Samut Sakorn
BANGKOK
Samut Songkhram
Phetchaburi
Chonburi
Navai Base
Rayong
Chanthaburi
Trat
N
0
50
100 Km
Arsenic (As) concentration in seafloor sediment
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105
Arsenic (As) concentration level (mg/kg)

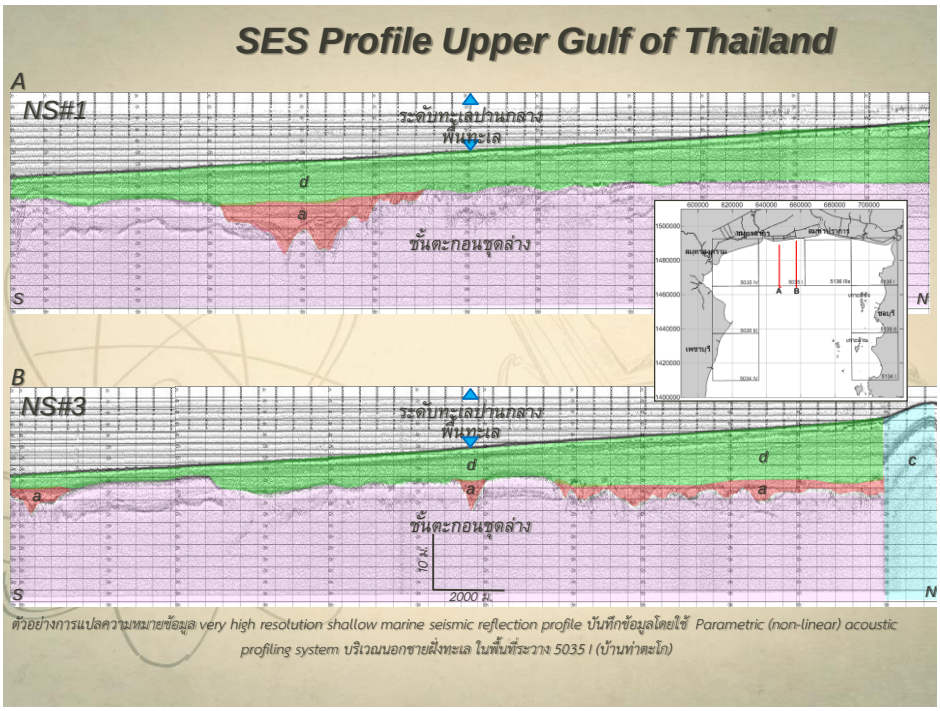

600000 620000 640000 660000 680000 700000 720000 740000 760000 780000 800000 820000 840000 860000 880000 900000 920000
1520000
1500000
1480000
1460000
1440000
1420000
1400000
1380000
1360000
1340000
1320000
1300000
1280000
Samut Sakorn
BANGKOK
Samut Songkhram
Phetchaburi
Chonburi
Rayong
Chanthaburi
Trat
N
0
50
100
Km
Cadmium (Cd) concentration in seafloor sediment
0.15 0.25 0.35 0.45 0.55 0.65 0.75 0.85 0.95
Cd concentration level (mg/kg)



แผนที่แสดงความหนาของชั้นตะกอนร่วนชุดบนในพื้นที่สำรวจ

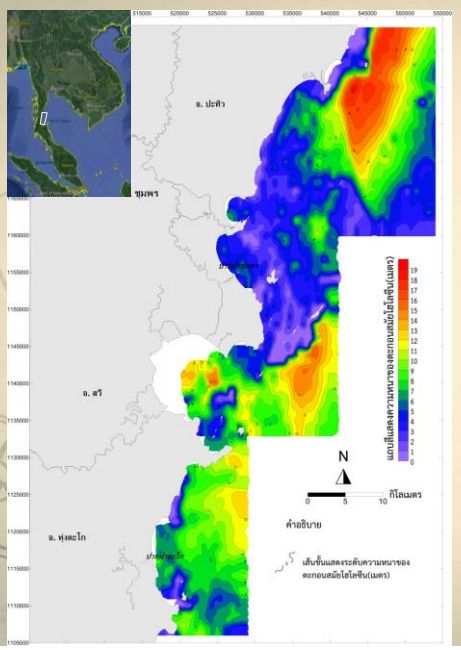
ตัวอย่าง seismic reflection section บริเวณคลองเกาะเสม็ดตอนล่าง

ตัวอย่าง seismic reflection section บริเวณคลองลัดท่าชีตอนล่าง

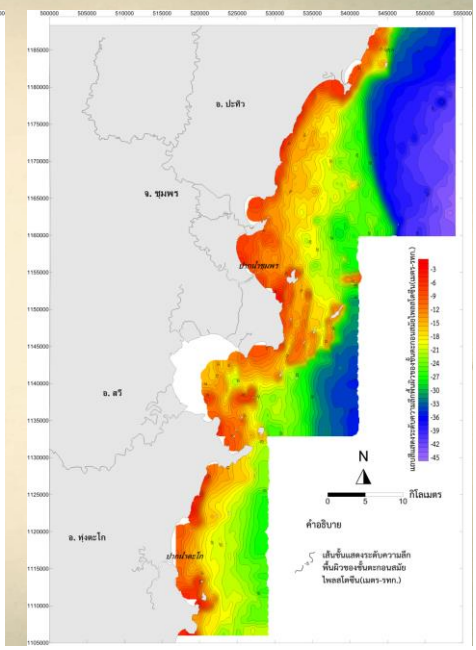


ตัวอย่างการแปลความหมายข้อมูล very high resolution shallow marine seismic reflection profile บันทึกข้อมูลโดยใช้ Parametric (non-linear) acoustic profiling system บริเวณนอกชายฝั่งทะเล ในพื้นที่ระวาง 5035 I (บ้านท่าตะโก)

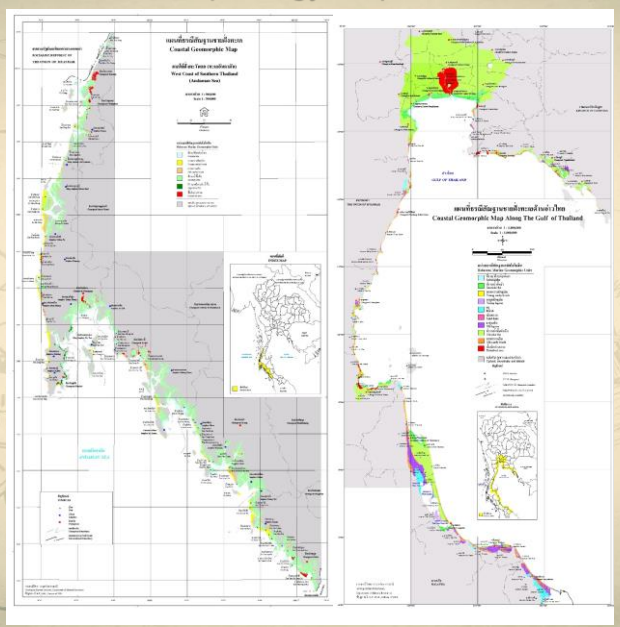
Holocene Sediment Isopach map



Pleistocene Surface Depth map



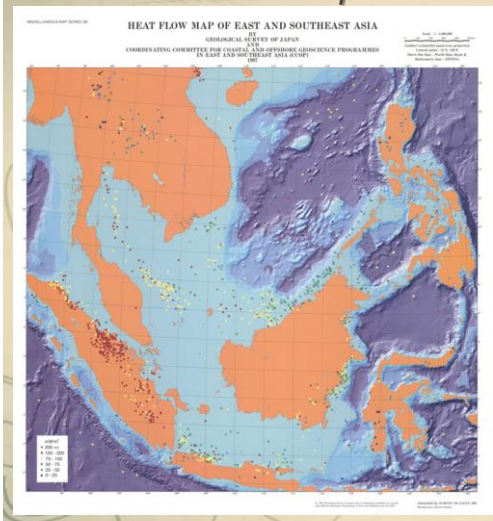
Coastal Geomorphology Map of Thailand, 2001



Coastal erosion situation, 2018

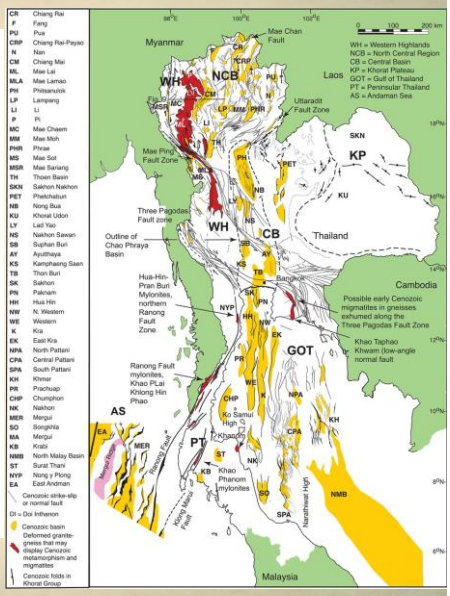
2. Marine Geology survey, mapping, and compilation, done by other agencies, e.g. CCOP and AIST, MGS

Heat flow Map

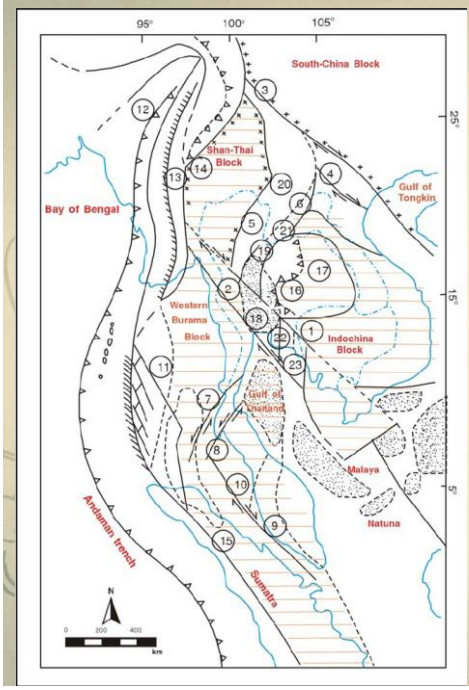


https://www.gsj.jp/Map/EN/asia-area-geoscience.html

Major Cenozoic Structure and Basins



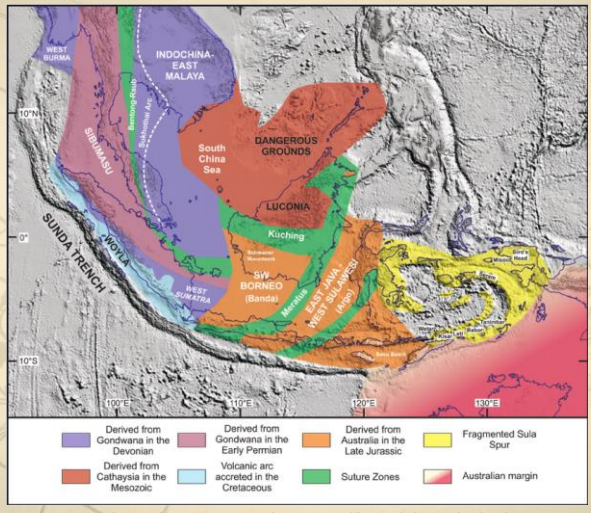
https://www.researchgate.net/figure/Location-of-major-Cenozoic-structural-features-and-basins-in-Thailand_fig1_285751625



Tectonic map of Southeast Asia showing major structures, basins, and tectonic blocks

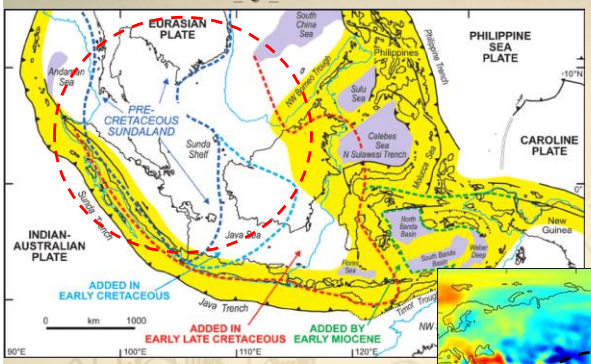
https://www.researchgate.net/figure/Tectonic-map-of-Southeast-Asia-showing-major-structures-basins-and-tectonic-blocks_fig1_268186894

The principal blocks in SE Asia

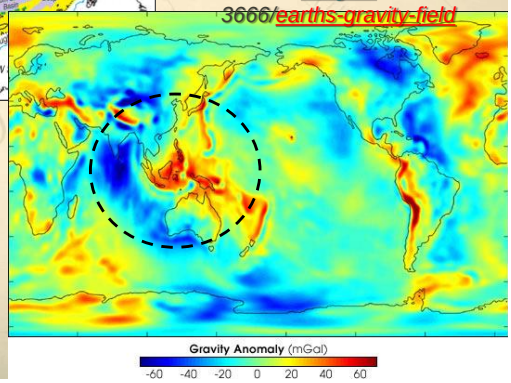


https://www.researchgate.net/figure/The-principal-blocks-in-SE-Asia-Ophiolitic-arc-sutures-are-shaded-in-green-The_fig1_254218249

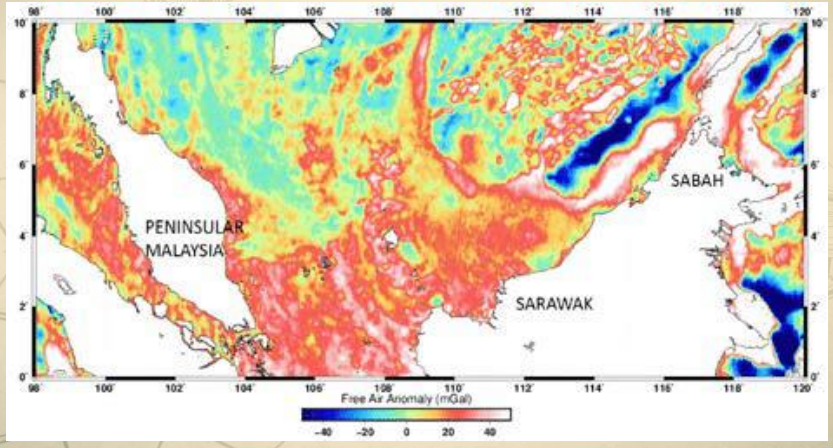
https://www.researchgate.net/figure/The-Mesozoic-and-Cenozoic-growth-of-Sundaland-Late-Triassic-Sundaland-is-outlined-in_fig2_254218249



https://earthobservatory.nasa.gov/images/3666/earths-gravity-field



Free air gravity anomaly map of offshore Malaysia and surrounding region based on satellite-derived global grid



https://www.researchgate.net/figure/Free-air-gravity-anomaly-map-of-offshore-Malaysia-and-surrounding-region-based-

3. Some Marine Research Works
done by
Department of Marine and Coastal Resources (DMCR)
and First Institute of Oceanography (FIO)

under MOU (2011) between

Ministry of Natural Resources and Environment, Thailand
and
State Oceanic Administration (SOA), China.

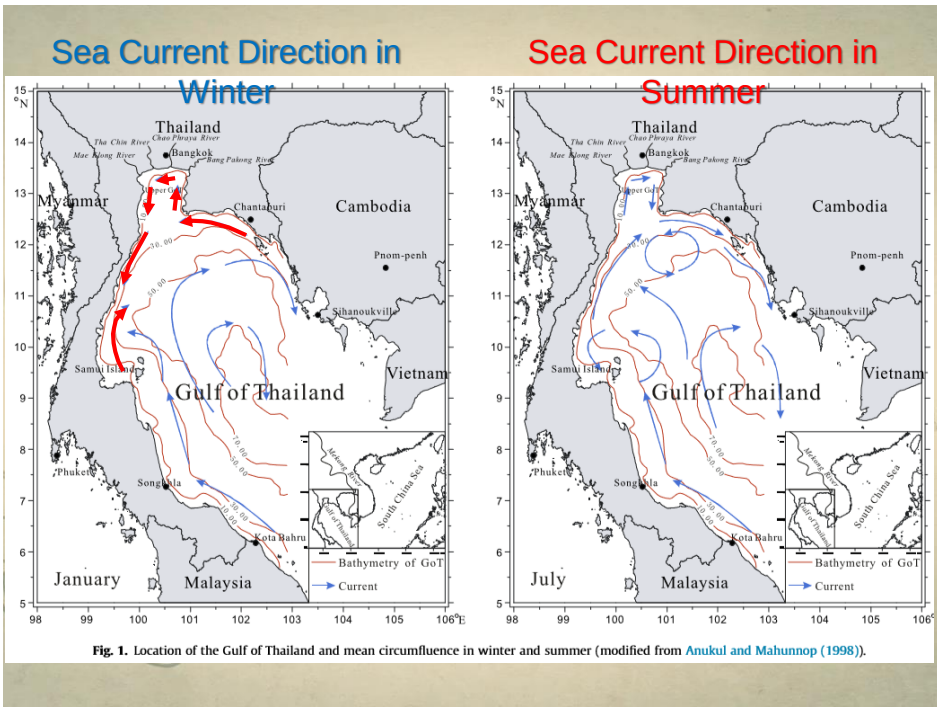
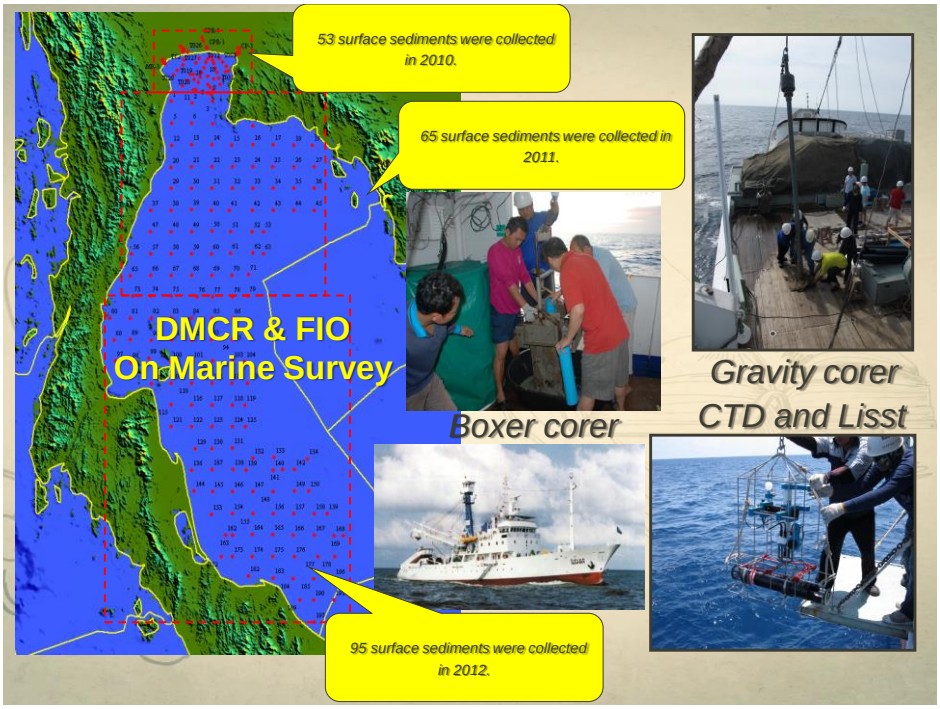


Fig. 1. Location of the Gulf of Thailand and mean circumfluence in winter and summer (modified from Anukul and Mahunnop (1998)).



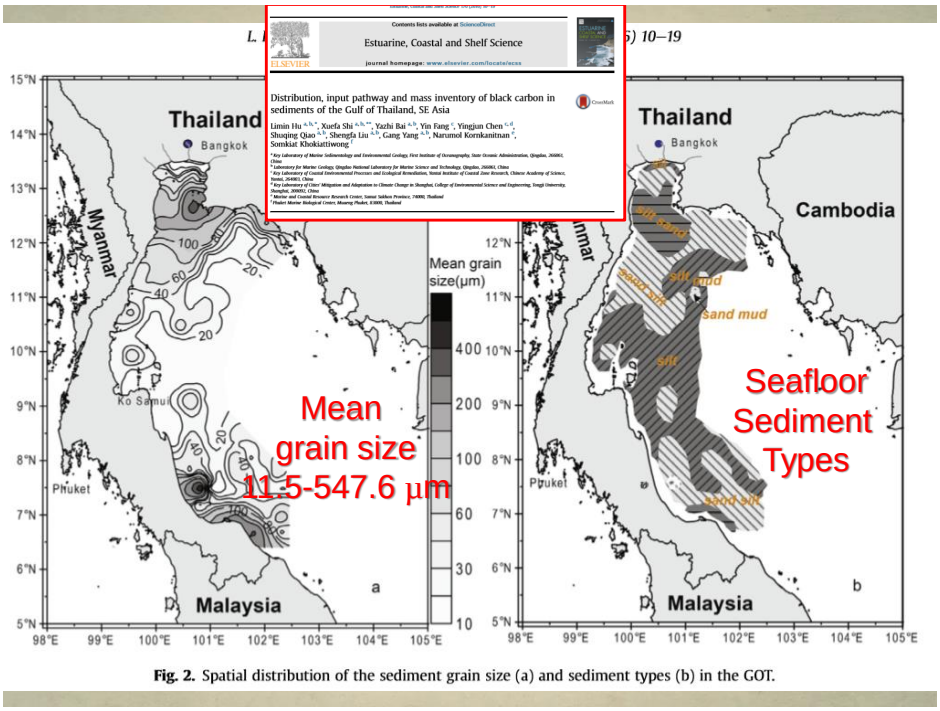


Fig. 2. Spatial distribution of the sediment grain size (a) and sediment types (b) in the GOT.

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Distribution, input pathway and mass inventory of black carbon in sediments of the Gulf of Thailand, SE Asia

Limin Hu [a, b, *], Xuefa Shi [a, b, **], Yazhi Bai [a, b], Yin Fang [c], Yingjun Chen [c, d], Shuqing Qiao [a, b], Shengfa Liu [a, b], Gang Yang [a, b], Narumol Kornkanitnan [e], Somkiat Khokiattiwong [f]

[a] Key Laboratory of Marine Sedimentology and Environmental Geology, First Institute of Oceanography, State Oceanic Administration, Qingdao, 266061, China
[b] Laboratory for Marine Geology, Qingdao National Laboratory for Marine Science and Technology, Qingdao, 266061, China
[c] Key Laboratory of Coastal Environmental Processes and Ecological Remediation, Yantai Institute of Coastal Zone Research, Chinese Academy of Science, Yantai, 264003, China
[d] Key Laboratory of Cities' Mitigation and Adaptation to Climate Change in Shanghai, College of Environmental Science and Engineering, Tongji University, Shanghai, 200092, China
[e] Marine and Coastal Resource Research Center, Samut Sakhon Province, 74000, Thailand
[f] Phuket Marine Biological Center, Muaeng Phuket, 83000, Thailand

afloor sediment distribution in the Gulf of Thailand

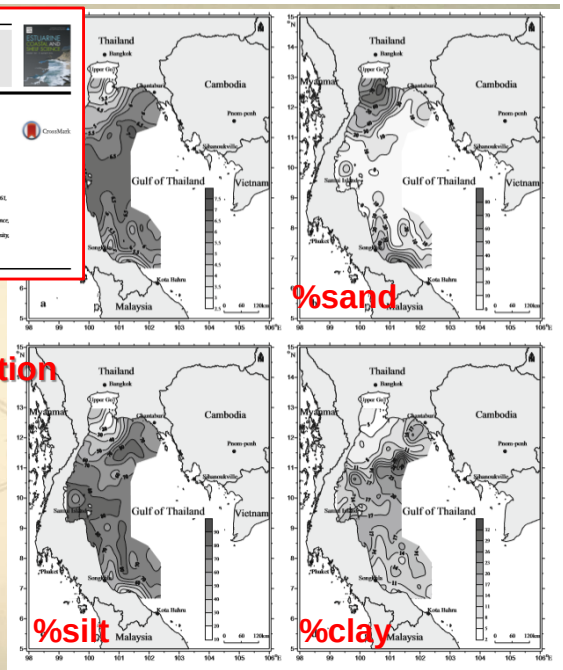


Fig. 3 Distribution of mean grain size, sand, silt, and clay in the study area (a mean grain size, b sand, c silt, and d clay. Kriging interpolation methods were used in these figures)

Acta Oceanol. Sin., 2015, Vol. 34, No. 12, P. 125–136
DOI: 10.1007/s13131-015-0772-y
http://www.hyxb.org.cn
E-mail: hyxbe@263.net

Distribution and composition of authigenic minerals in surface sediments of the western Gulf of Thailand

WANG Kunshan[1, 2*], SHI Xuefa[1, 2], QIAO Shuqing[1, 2], KORNKANITNAN Narumol[3], KHOKIATTIWONG Somkiat[4]

siderite

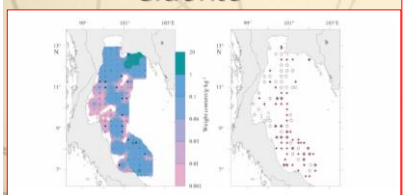


Fig. 3. Distribution of weight content (g/kg) (a) and different occurrence types (b) of siderite in the surface sediment of the western Gulf of Thailand. Empty circles represent transparent grains (Table 1), filled circles represent mature grains (Table 2), and plus signs represent weathered grains (Table 3).

pyrite glauconite chlorite plagioclase

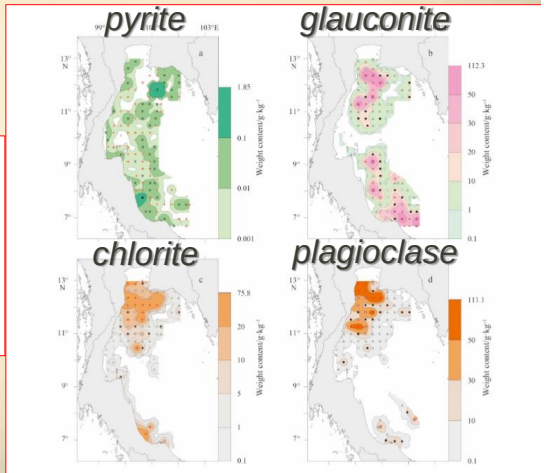


Fig. 5. Distribution of weight content of pyrite (a), glauconite (b), chlorite (c), and plagioclase (d) in the surface sediment of the western Gulf of Thailand.

Contents lists available at ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

Distribution of clay minerals in surface sediments of the western Gulf of Thailand: Sources and transport patterns

Xuefa Shi [a,b,*], Shengfa Liu [a,b], Xisheng Fang [a,b], Shuqing Qiao [a,b], Somkiat Khokiattiwong [c], Narumol Kornkanitnan [d]

[a] Key Laboratory of Marine Sedimentology and Environmental Geology, First Institute of Oceanography, SOA, Qingdao 266061, PR China
[b] Function Laboratory for Marine Geology, National Oceanography Laboratory, Qingdao 266061, PR China
[c] Phuket Marine Biological Center, Phuket 83000, Thailand
[d] Marine and Coastal Resource Research Center, Samut Sakhon Province 74000, Thailand

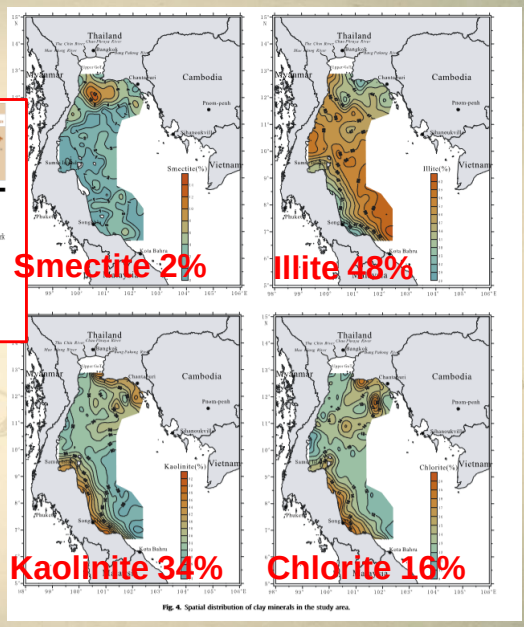
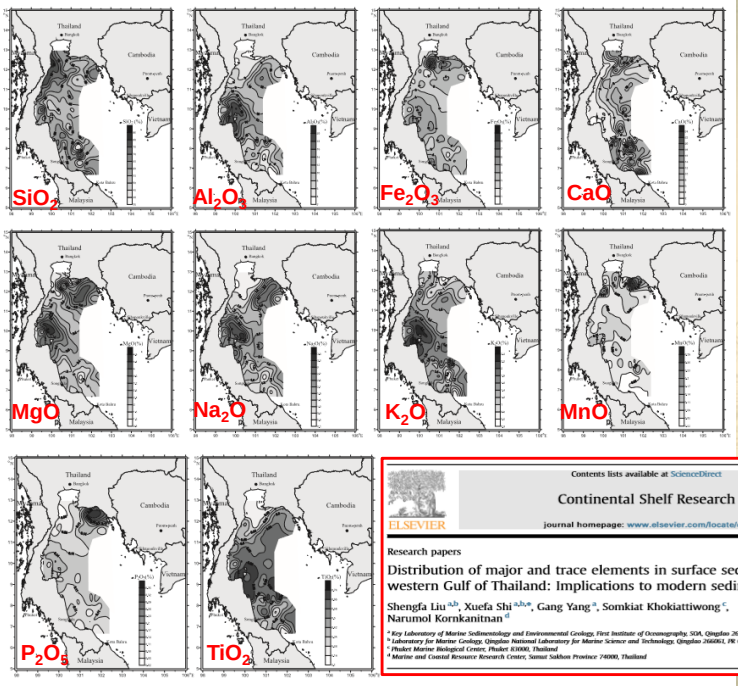


Fig. 4. Spatial distribution of clay minerals in the study area.



Major Elements

Contents lists available at ScienceDirect

Continental Shelf Research

journal homepage: www.elsevier.com/locate/csr

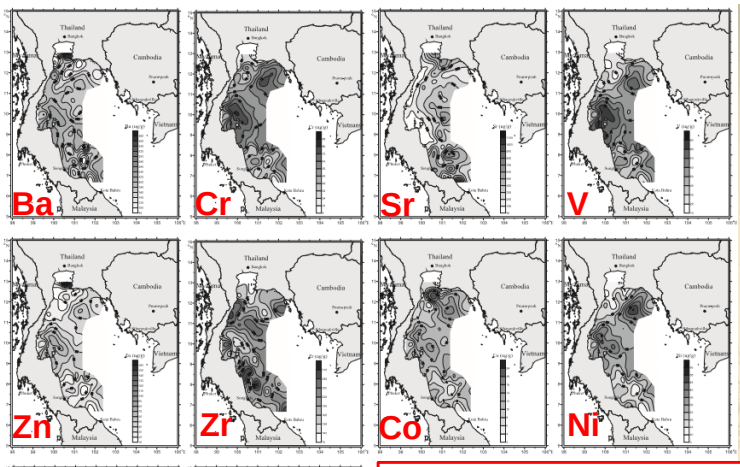
Research papers

Distribution of major and trace elements in surface sediments of the western Gulf of Thailand: Implications to modern sedimentation

Shengfa Liu [a,b], Xuefa Shi [a,b,*], Gang Yang [a], Somkiat Khokiattiwong [c], Narumol Kornkanitnan [d]

[a] Key Laboratory of Marine Sedimentology and Environmental Geology, First Institute of Oceanography, SOA, Qingdao 266061, PR China
[b] Laboratory for Marine Geology, Qingdao National Laboratory for Marine Science and Technology, Qingdao 266061, PR China
[c] Phuket Marine Biological Center, Phuket 83000, Thailand
[d] Marine and Coastal Resource Research Center, Samut Sakhon Province 74000, Thailand

Fig. 4. Distribution of major elements in the surface sediments of the study area (unit is %).



Trace Elements

Contents lists available at ScienceDirect
Continental Shelf Research
journal homepage: www.elsevier.com/locate/csr

Research papers

Distribution of major and trace elements in surface sediments of the western Gulf of Thailand: Implications to modern sedimentation

Shengfa Liu [a,b], Xuefa Shi [a,b,*], Gang Yang [a], Somkiat Khokiattiwong [c], Narumol Kornkanitnan [d]

[a] Key Laboratory of Marine Sedimentology and Environmental Geology, First Institute of Oceanography, SOA, Qingdao 266061, PR China
[b] Laboratory for Marine Geology, Qingdao National Laboratory for Marine Science and Technology, Qingdao 266061, PR China
[c] Phuket Marine Biological Center, Phuket 83000, Thailand
[d] Marine and Coastal Resource Research Center, Samut Sakhon Province 74000, Thailand

Fig. 5. Distribution of trace elements in the surface sediments of the study area (unit is μg/g).

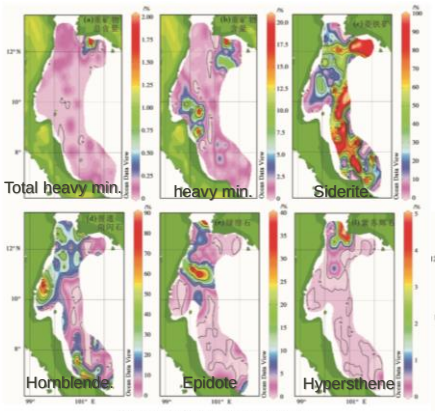


图 2 泰国湾表层沉积物重矿物重量含量及矿物分布

Fig. 2 Distribution of weight content of heavy minerals and content of minerals in surface sediment from western Gulf of Thail

SPATIAL DISTRIBUTION OF HEAVY MINERALS IN THE SURFACE SEDIMENTS FROM THE WESTERN GULF OF THAILAND: IMPLICATIONS FOR SEDIMENT PROVENANCE AND SEDIMENTARY ENVIRONMENT

Wang Kunshan① Shi Xuefa① Liu Shengfa① Qiao Shuqing①
Yang Gang① Hu Limin① K.Narumol② K.Somkiat③
(①Key Laboratory of Marine Sedimentology & Environmental Geology, First Institute of Oceanography, State Oceanic Administration, Qingdao 266061; ②Marine and Coastal Resource Research Center, Samut Sakhon Province 74000, Thailand; ③Phuket Marine Biological Center, Muaeng Phuket 83000, Thailand)

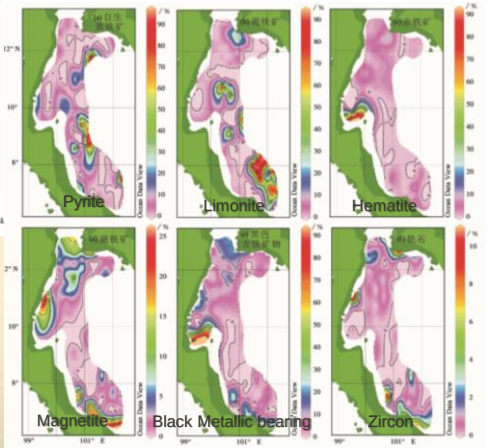


图 3 泰国湾表层沉积物重矿物中含铁矿物及锆石分布

Fig. 3 Distribution of content of ferric mineral and zircon in surface sediment from western Gulf of Thailand

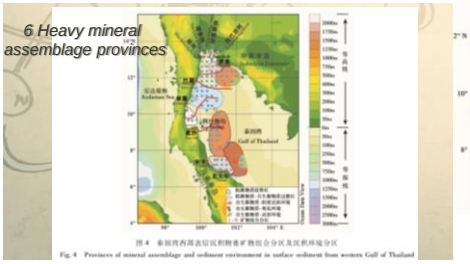


图 4 泰国湾西部表层沉积物重矿物组合分区及沉积环境分区

Fig. 4 Provinces of mineral assemblage and sediment environment in surface sediment from western Gulf of Thailand

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Distribution, input pathway and mass inventory of black carbon in sediments of the Gulf of Thailand, SE Asia

Limin Hu [a, b, *], Xuefa Shi [a, b, **], Yazhi Bai [a, b], Yin Fang [c], Yingjun Chen [d], Shuqing Qiao [a, b], Shengfa Liu [a, b], Gang Yang [a, b], Narumol Kornkanitnan [e], Somkiat Khokiattiwong [f]

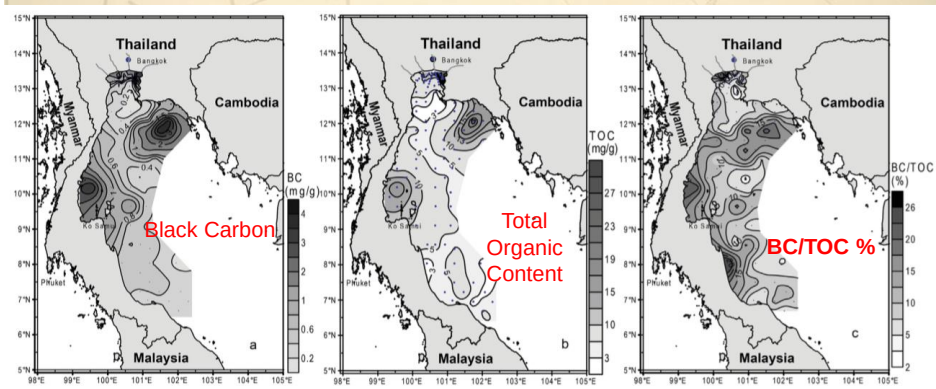


Fig. 3. Spatial distribution of the BC abundance (a), TOC contents (b) and BC/TOC% values (c).

RARE EARTH ELEMENT GEOCHEMISTRY OF SURFACE SEDIMENTS IN SOUTHEASTERN ANDAMAN SEA AND IMPLICATIONS FOR PROVENANCE

CAO Peng[1,2], SHI Xuefa[1,2], LI Weiran[1,2], LIU Shengfa[1,2], ZHUAimei[3], YANG Gang[4], Somkiat Khokiattiwong[5], Narumol Kornkanitnan[5]

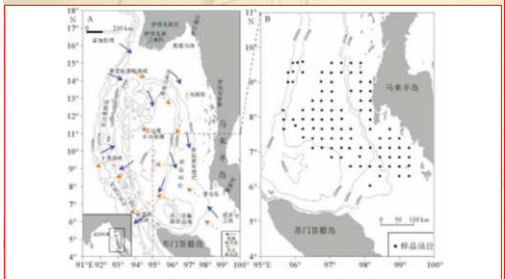


图 1 研究区位置与海流模式及取样站位(流系改绘自文献[19])

Fig. 1 The Location of the study area, circulation patterns and sampling sites (circulation patterns are modified from [19])

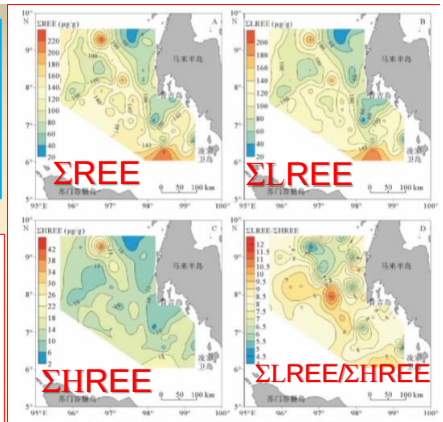


图 3 安达曼海东南部海域沉积物 ΣREE、ΣLREE、ΣHREE 以及 ΣLREE/ΣHREE 分布

Fig. 3 ΣREE, ΣLREE, ΣHREE and ΣLREE/ΣHREE distribution for sediments of the southeastern Andaman S

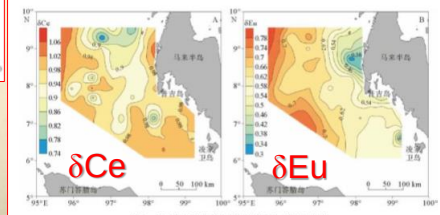


图 4 安达曼海东南部海域沉积物 δCe 和 δEu 分布

Fig. 4 δCe and δEu distribution for sediments of the southeastern Andaman Sea

REE geochemistry in the Andaman Sea

Comparison Status of QIMG vs DMR on Marine Geology Work

QIMG

Firm Organization

DMR

Sporadic works on marine geolo

1979 - 2000 (22 years)
Offshore prospecting for Ti and heavy minerals Sectio

2001 – 2010 (10 years)
Offshore Mineral Section
(a few work on marine geology)

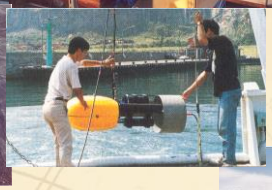
2011-2018 (8 years)
Marine Geology Section

8 October 2018
Marine Geology Section was Dissolved

Limitations of DMR on rine Geological Research and Survey Mappi

1. Limited Survey Budget
2. Limited Survey Equipment
3. Limited Key Laboratory ana
4. Limited Expertise Personne
5. No own Survey Vessel

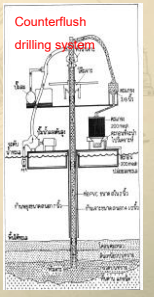
Year 1981-2000
Survey equipments



Single channel seismic reflection profiling system (1981-2000)

Side-scan sonar (1995-2000)

Drilling Barge (1981-1999)



Survey Equipments 2004-present

Sediment-Echo Sounder

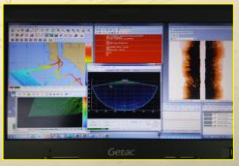
Automatic tide-gauge

ADCP

Marine Resistivity

Dredge sampler

GPS navigator

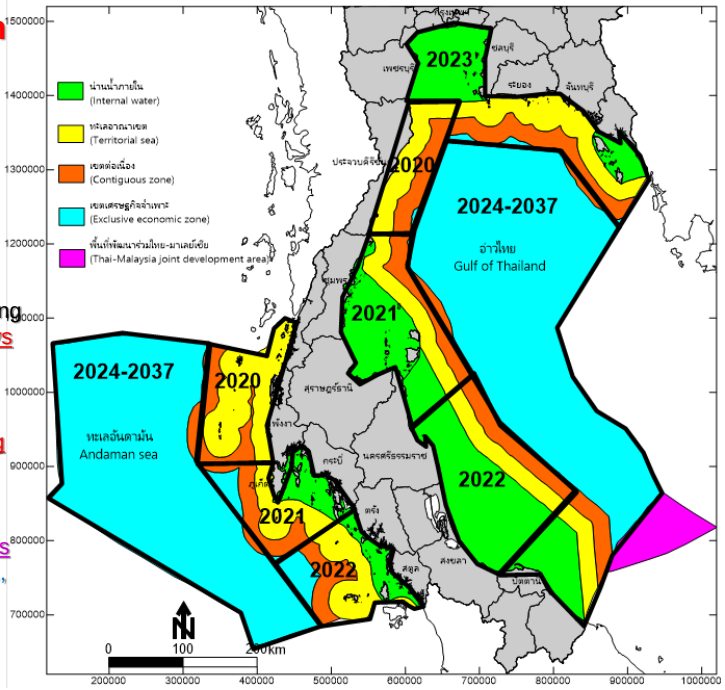


Multi-beam Echo sounder

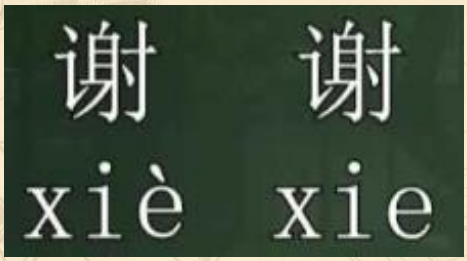
Future Dream Plan?? according to Thailand National Strategies 2018-2037

Marine Geology Mapping

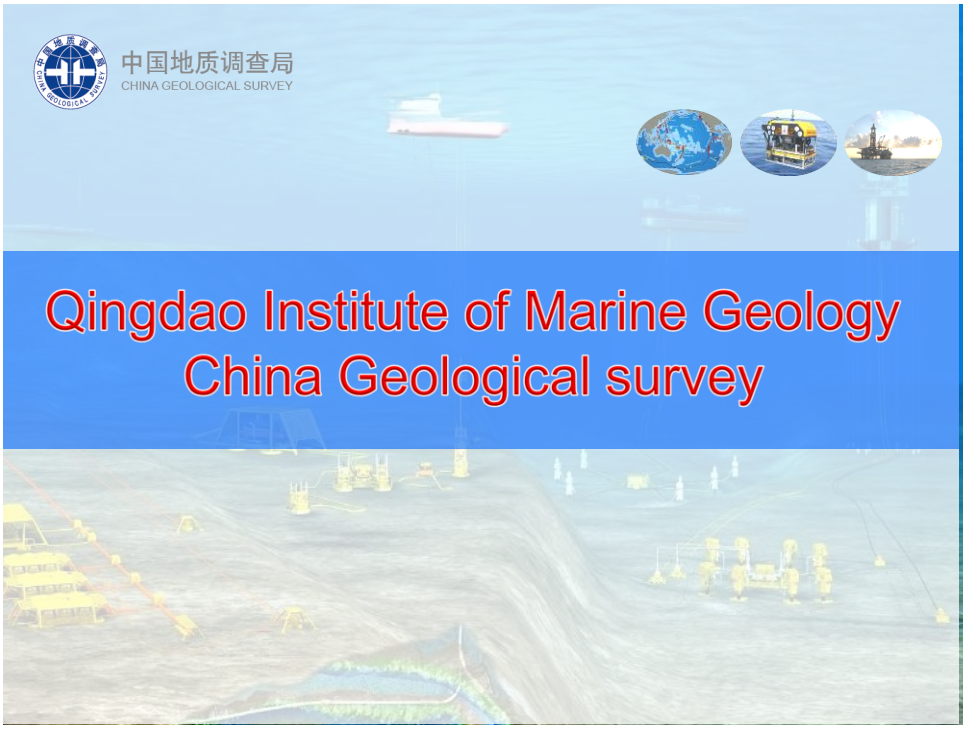
1. Geophysical surveys (Single and Multi-channel seismic, Magnetic)
2. Sediment sampling (surface and core sampling)
3. Laboratory analyses (sediment, heavy min., heavy metal, REE, clay min. etc)



Thank You Very Much



ANNEX V



1. Overview

History and location

62 Fuzhounan Road Qingdao, China
Base of Administration, research, and education

- 1964 - Institute of Marine Geology (Nanjing)
- 1979 - Institute of Marine Geology (Qingdao)
- 2000 - Qingdao Institute of Marine Geology, CGS

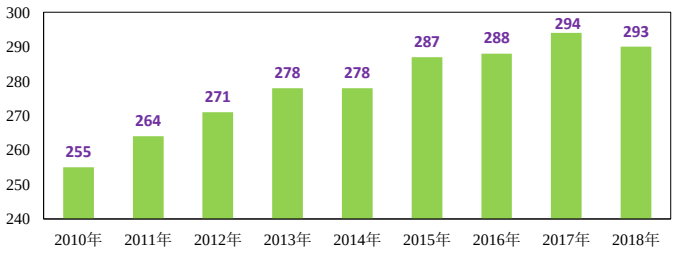
The East Base in BLUE SILICON VALLEY , Jimo East Research Base + a wharf of Hydrates drilling

中国地质调查局
CHINA GEOLOGICAL SURVEY

Employee Resources

- **Manning Quotas**

nearly 300 scientific and technical personnel, including 137 senior researchers and technicians, 8 doctoral instructors and 23 master student supervisors.



中国地质调查局
CHINA GEOLOGICAL SURVEY

Facilities

- **QIMG owns about 1500 equipment, including ocean survey equipment, integrated geophysical data processing equipment, experimental test equipment, geological information technology equipment.**

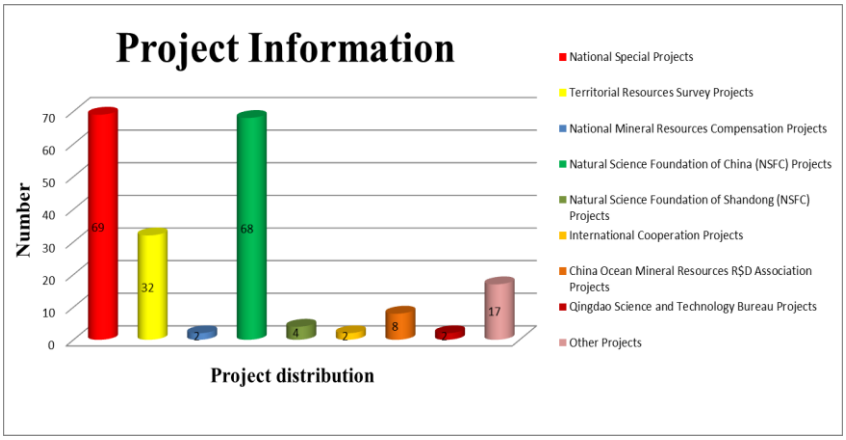
R/V "Yezhizheng"

R/V Hiyang Dizhi 9

中国地质调查局 CHINA GEOLOGICAL SURVEY

Project Information

- **Undertake more than 200 projects since 2006**



中国地质调查局 CHINA GEOLOGICAL SURVEY

On-going research directions

- Marine Regional Geological Survey
- Coastal zone integrated survey
- Marine Oil & Gas resources survey
- Urban geological survey
- Deep Sea Geological Survey

- Gas-hydrate exploration
- Gas-hydrate pilot production
- Geo-information
- Laboratory test and analysis

中国地质调查局 CHINA GEOLOGICAL SURVEY

2. Main Research Fields

中国地质调查局 CHINA GEOLOGICAL SURVEY

1. Marine Regional Geology
2. Integrated Costal Geology
3. Urban Geology
4. Marine Hydrocarbon Geology
5. Gas Hydrate Geology

中国地质调查局
CHINA GEOLOGICAL SURVEY

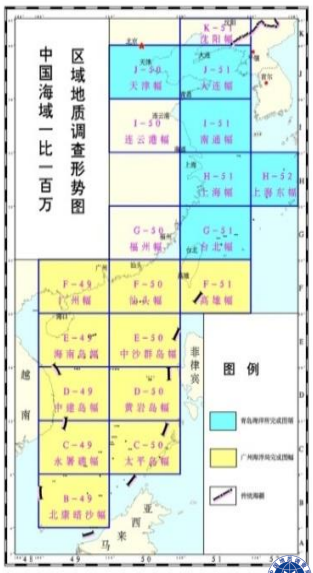
1. Marine Regional Geology

Marine geological mapping

Three scales of marine regional geological survey in three stages according to CGS overall design

- **1:1000,000 16 sheets**
- **1:250,000 84 sheets**
- **1:50,000**

- Acquire basic data for marine geo-scientific research
- Establish professional standard for China's marine regional geological survey on the scale of 1:1000,000, 1:250,000



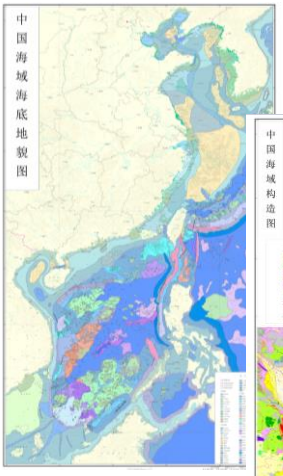
中国地质调查局
CHINA GEOLOGICAL SURVEY

1. Marine Regional Geology

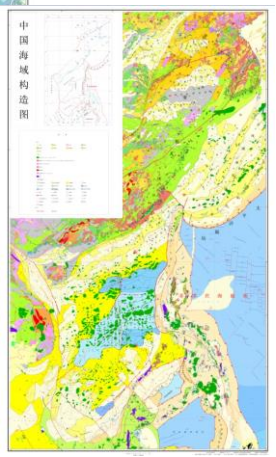
◆ Compile the first generation of the 1:1 million geological-geophysical-geochemical series of maps in China's jurisdictions is compiled.

◆ Establish the sea area geological space database.

◆ Study combed a series of major geological problems: the tectonic evolution of the Chinese sea area , the resources, environmental effects and surface system processes.



submarine geomorphologic map

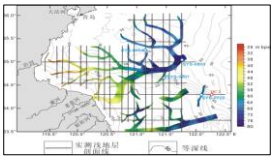


Tectonic map

中国地质调查局 CHINA GEOLOGICAL SURVEY

2. Integrated Coastal Geology

◆ **Conduct coastal environmental geological survey in middle-large scale**



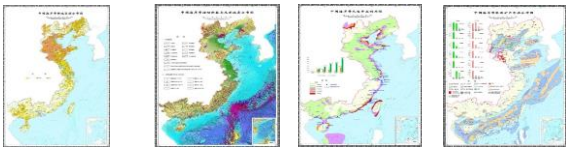
Distribution of paleochannel in the west continental shelf of south Yellow Sea

◆ **Conduct the integrated geological survey in coastal zone**

Sedimentary dynamic processes monitor for estuary land-sea effects of small and medium-sized rivers

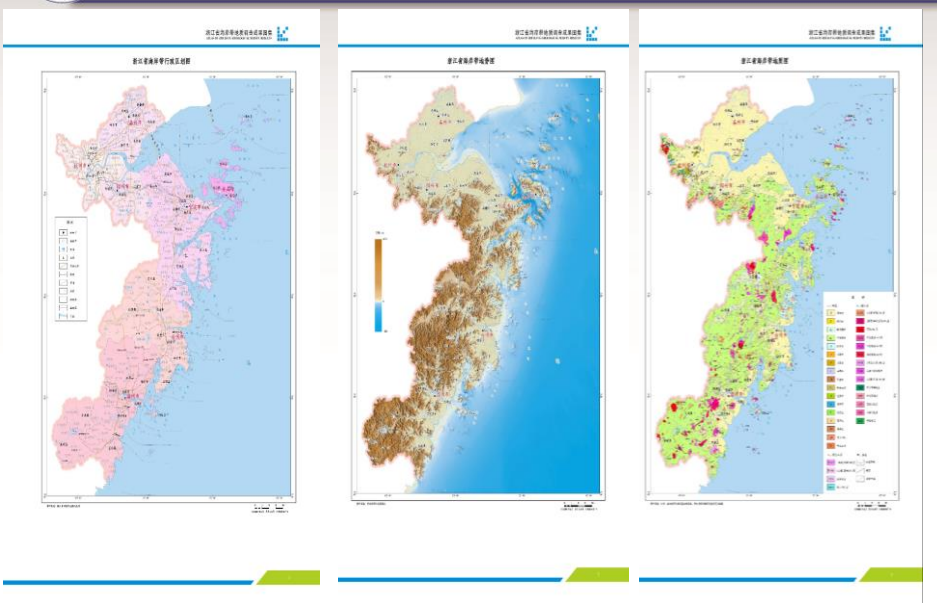
Erosion/deposition monitoring base in the coastal zone of east Hainan Island

◆ **Compile the《Chinese Geological Atlas of Coastal Zone Land and Resources and Environment》**

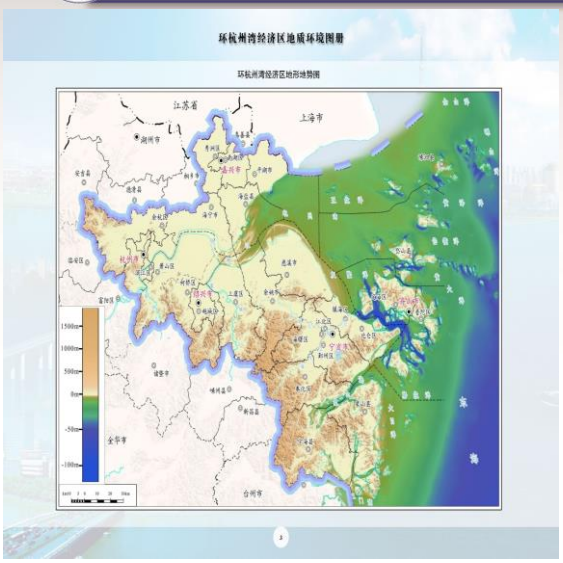


中国地质调查局 CHINA GEOLOGICAL SURVEY

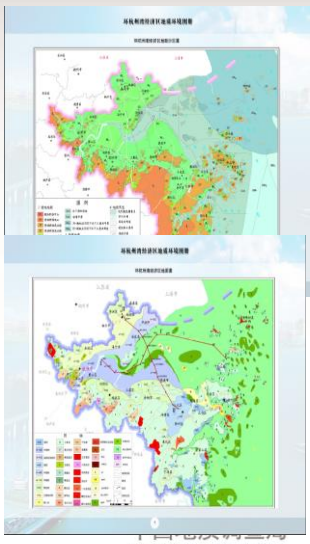
Coastal geological mapping



Coastal geological mapping



relief map



Coastal geo-hazard monitoring

Submarine Landslide

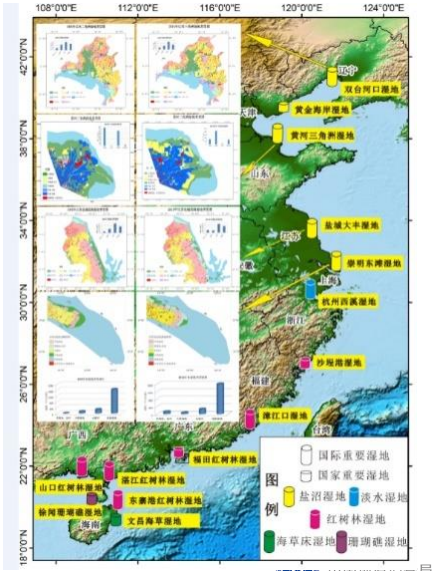
舟山绿色石化管委会提出建设包括气象、风暴潮、地面沉降、浅层气等综合监测系统

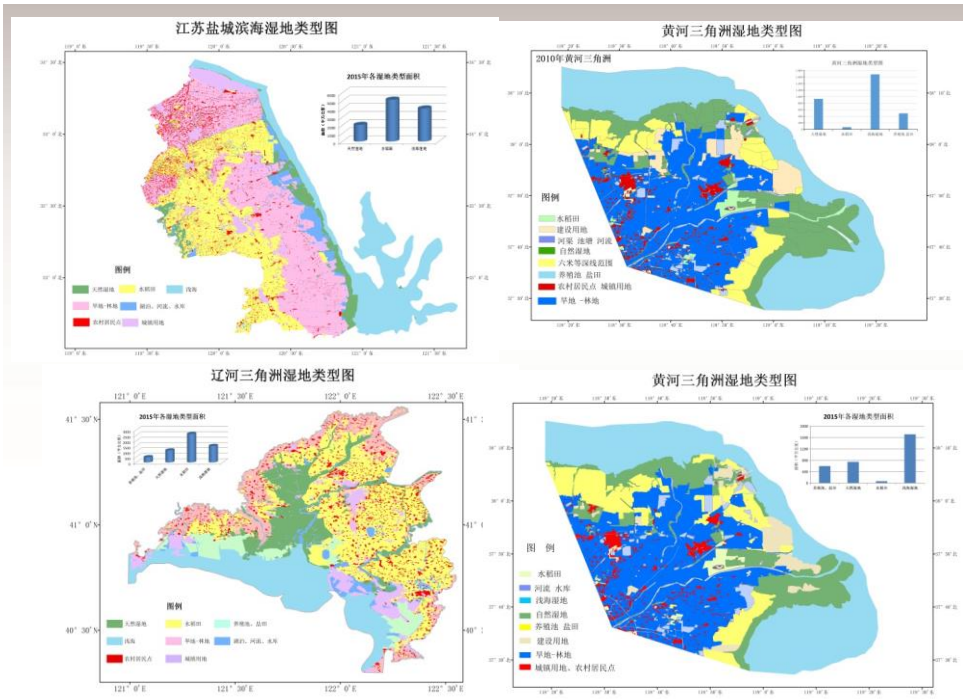
Engineering Geological geo-hazard

2. Integrated Coastal Geology（coastal wetlands）

◆ **National coastal wetland habitat mapping: carry out large-scale habitat mapping and mapping work in eight important coastal wetlands across the country,**

◆ **Build a global monitoring network for coastal wetland ecosystems. Propose and lead the implementation of the large-scale scientific plan for the global monitoring network of coastal wetland ecosystems, spanning Asia, Europe and North America.**

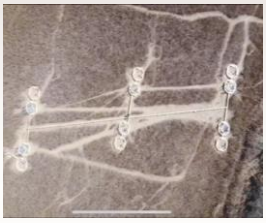




Global coastal wetland observation

盐城核心区CROWN-1

盐城试验区CROWN-2



盘锦 CROWN-4

东营CROWN-3

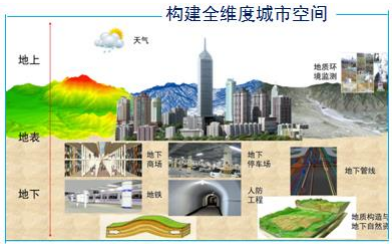
中国地质调查局
CHINA GEOLOGICAL SURVEY

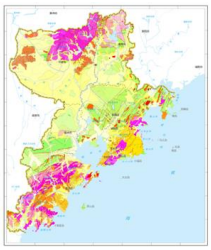
3. Urban Geology survey

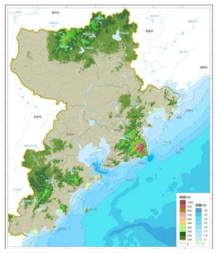
◆ Constructing a "transparent Qingdao" of land and sea

◆ Establishing a demonstration base for the investigation and utilization of underground space resources in coastal bedrock cities

◆ Providing geological solutions for natural resource planning, construction and operation management in Qingdao





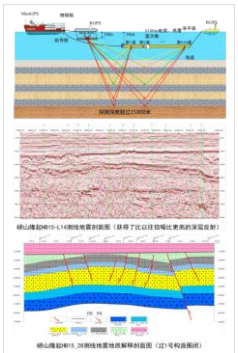


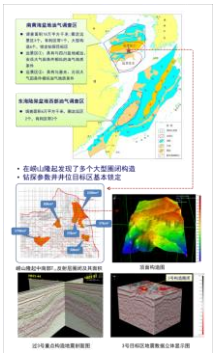
中国地质调查局 青岛海洋地质研究所

4. Marine Hydrocarbon Geology

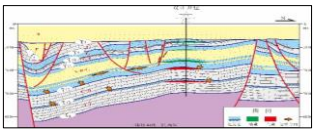
◆ "High, Rich, Strong" (high coverage, rich low-frequency, strong seismic source) seismic survey technology

◆ Obtain a new discovery of oil and gas resources survey in the South Yellow Sea





◆ Enrich the theory of oil and gas reservoir in the South Yellow Sea



prognostic chart for hydrocarbon reservoir mode in the Loshan uplift

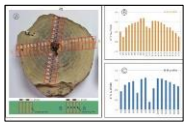
中国地质调查局 CHINA GEOLOGICAL SURVEY

5. Gas Hydrate Geology

Hydrate Resources Investigation

◆ **A new discovery of hydrate survey**

Cold seep carbonate samples



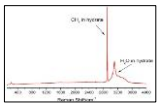
Test results for cold seep carbonate samples

Combustion of hydrate sample

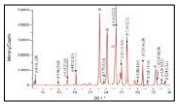
◆ **A major breakthrough of hydrate survey**

Massive hydrate sample

Lamellar hydrate sample



Laser Raman spectra

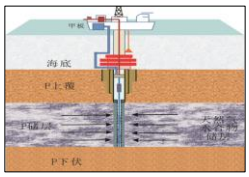


x-ray diffraction spectrogram

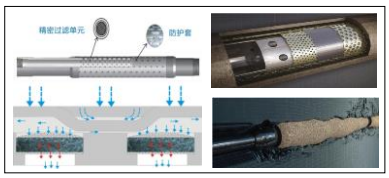
5. Gas Hydrate Geology

Hydrate pilot production research

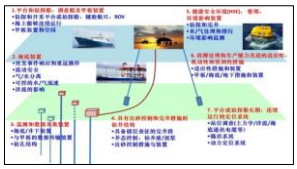
◆ **Overcome the production problem of sandy hydrate reservoir, and implement the pilot production of silt-sandy hydrate reservoir for the first time in the world**



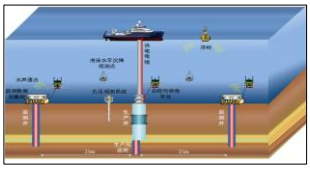
A sketch for Stratum Fluid Extraction Method



A sketch for sand prevention pipe and sand prevention mode



Structure for hydrate pilot production system



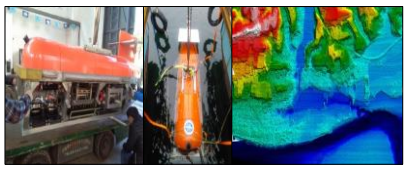
Hydrate pilot production monitoring system for reservoir temperature and porosity pressure

中国地质调查局
CHINA GEOLOGICAL SURVEY

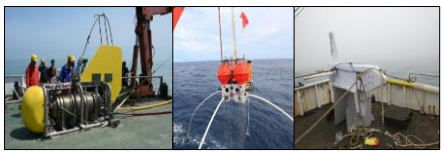
3. Supporting Facilities

中国地质调查局
CHINA GEOLOGICAL SURVEY

1. Exploration facilities and equipment



3000m-level acoustics drag system



Marine electromagnetic detection, transmitting and receiving system with controllable source

Multi-channel seismic acquisition system with small trace space and high resolution

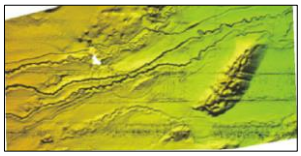
Multi-parameter seafloor integrated observation system

Field mobile laboratory

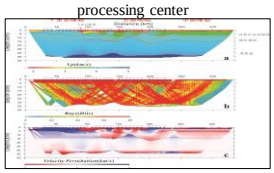
中国地质调查局
CHINA GEOLOGICAL SURVEY

2. Data Processing

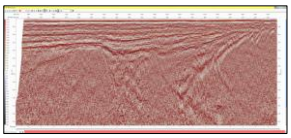
Computer cluster in data processing center



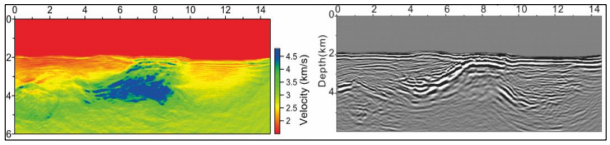
Multi-beam imaging on seafloor



A model of OBS detective velocity profile in the south of Yellow Sea



Long-cable seismic data processing result



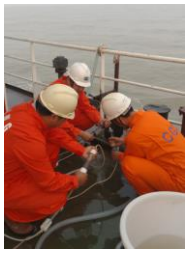
Velocity field and inversion results

中国地质调查局 CHINA GEOLOGICAL SURVEY

3. Experimental test technique

◆ **Develop national standard materials and methods, Developed relevant industry standards**

China's first set of standard materials for oceanic nodules and marine sediments

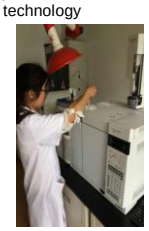


Method for enrichment determination of radium isotopes in marine systems

Modern inorganic element determination technology for marine sediments

Advanced jewellery and jade identification technology

Young geological dating technique for marine sediments



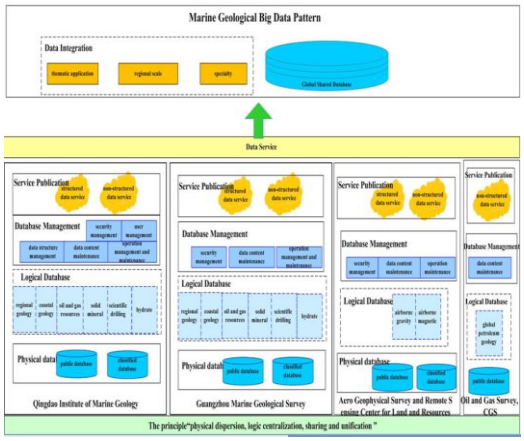
Gas component rapid calibration technology

◆ **Develop new marine testing technology**

中国地质调查局 CHINA GEOLOGICAL SURVEY

4. Marine Geological Information

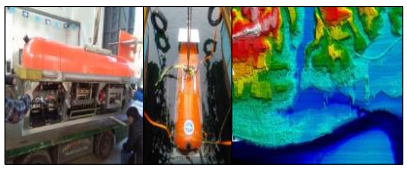
- **Constructed a unified marine geological data resource system**



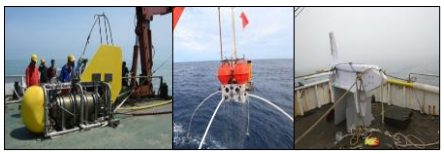
- **Established a unified national marine geological information service system, provide multi-level marine geological information services**

中国地质调查局
CHINA GEOLOGICAL SURVEY

Core Technology - Ocean Exploration



3000m-level acoustics drag system



Marine electromagnetic detection, transmitting and receiving system with controllable source

Multi-channel seismic acquisition system with small trace space and high resolution

Multi-parameter seafloor integrated observation system

Field mobile laboratory

中国地质调查局
CHINA GEOLOGICAL SURVEY

中国地质调查局
CHINA GEOLOGICAL SURVEY

Looking forwards to cooperation

中国地质调查局
CHINA GEOLOGICAL SURVEY

中国海域基础地质调查

Marine Regional geological Survey in China

Mr.Wen Zhenhe

Qingdao Institute of Marine Geology, CGS.

Oct.16,2018 Bangkok

OUTLINE

一、Overview

二、Technology

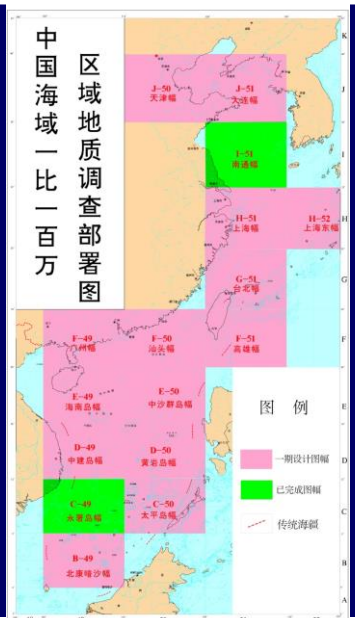
三、Main Achievement

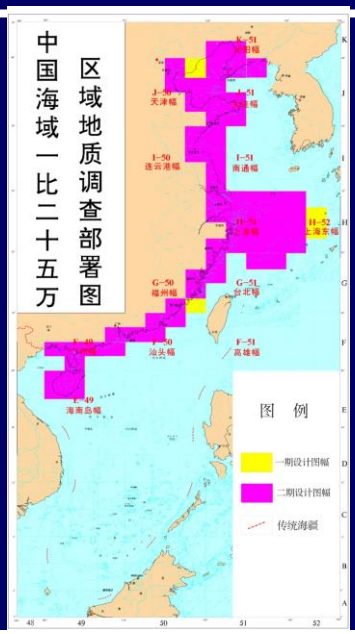
一、Overview

中国东部、南部分布广阔海域

coastline > 18000 km

国际分幅：16幅1:100万图幅； 64幅1:25万图幅





1. Marine geological mapping(1:1M)

按国际标准图幅，首先开展1：100万海洋区域地质调查示范工作，建立相关技术规范，为进一步开展中国管辖海域1：100万海洋区域地质调查奠定基础。

➢1：100万海洋区调按国际标准分幅（4╳6度），大致16个图幅。

2. Marine geological mapping (1:250 000)

◆**Done:** 青岛幅**1个图幅试点**

◆**On-going:** 营口幅、锦西幅、日照幅、连云港幅、霞浦县幅、福州幅、莆田幅、泉州幅、厦门幅、乐东幅、三沙市幅等**15个图幅；**

◆**2018年：**将完成**12个图幅**

OUTLINE

一、 Overview

二、 Technology

三、 Main achievement

Geological mapping different from land to offshore:

1. 调查工区普遍被海水覆盖，不像陆地区“看得见，摸得着”；海底地形地貌是一项重要的调查研究内容。

2. 大部分地区沉积有第四纪地层，厚度有几米至10000米不等。少数地区为基岩海岛、冲蚀出露基岩

二、Marine geological mapping Technology

(1) Geological mapping technology：

表层地质取样、柱状地质取样、海底浅层钻探等。

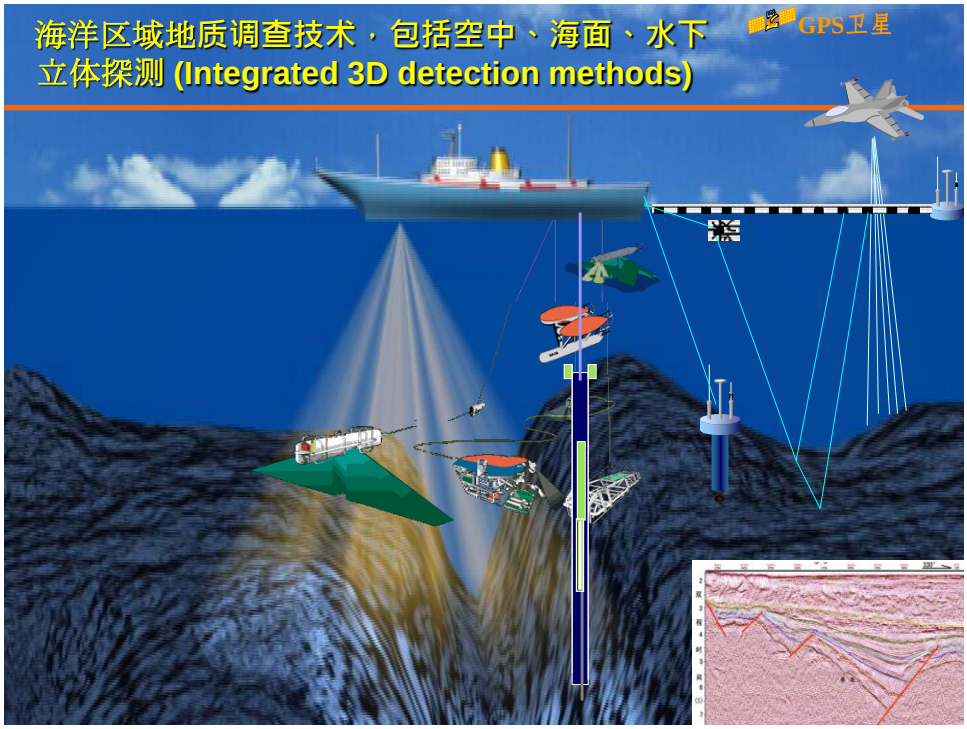
(2) Geophysical technology：

水深测量（单波束测深、多波束测深）、侧扫声纳测量、浅地层剖面测量、单道地震测量、多道地震测量、OBS、重力测量（卫星重力和海洋重力）、磁力测量（航空磁力和海洋磁力）、遥感调查和低层大气样品采集等。

Regional geological mapping contents

主要技术手段	主要技术方法
地形地貌测量	多波束测深
	双频、单频回声测深
	侧扫声纳
地球物理测量	浅地层剖面
	单道地震
	多道地震
	海洋重力（含卫星重力）
	海洋磁力
底质调查	海底表层地质取样
	海底柱状地质取样
	潮间带柱状地质取样
地质钻探	潮间带浅钻
	海域浅钻
其他	样品分析测试
	卫星遥感资料综合解释
	低层大气取样及分析测试
	数据库及其支持系统开发建设

海洋区域地质调查技术，包括空中、海面、水下立体探测 (Integrated 3D detection methods)



Geological mapping——表层样、柱状样、浅钻

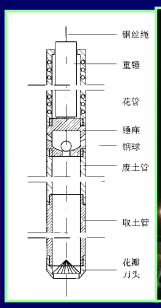
表层样

箱式取样、抓斗取样和拖网取样。

柱状样

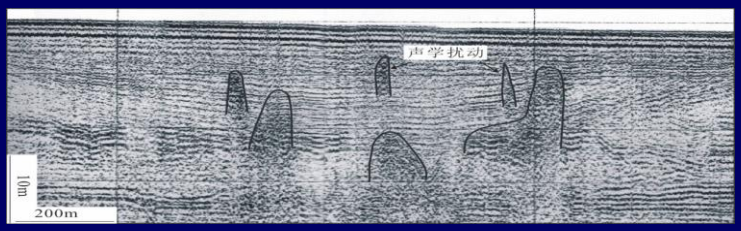
重力取样和振动活塞取样

海底浅钻



Geophysical mapping——浅地层剖面测量

浅地层剖面测量是海洋地球物理调查的常规手段之一，其主要目的是揭示海底面以下70m以浅的沉积地层，以此来划分地层层序，研究沉积结构、时空格架、发育历史及海侵海退、古气候变化等。



浅地层剖面

Geophysical mapping——单道、多道地震测量

单道地震测量是介于多道地震和浅地层剖面测量之间的一种地球物理勘探方法，是研究中深部地层（中更新统—古近系）分布状况及结构构造、新构造运动特征和岩浆活动规律的有效手段。

多道地震测量是海洋地球物理调查的重要工作手段之一，记录剖面具有较高的信噪比和分辨率，以期了解各坳陷和隆起内地层发育分布情况、断裂组合、构造单元边界接触性质，分析盆地形成演化机制。

Geophysical mapping——重力、磁力测量

重力测量方法包括海洋重力测量、航空重力测量和卫星重力测量，在海洋区调工作中，航空重力数据和卫星重力数据主要是对海测数据进行必要的补充。

磁力测量方法包括海洋磁力测量和航空磁力测量，在海洋区调工作中，航空磁力数据主要是对海测数据进行必要的补充。

Remote sensing——遥感调查

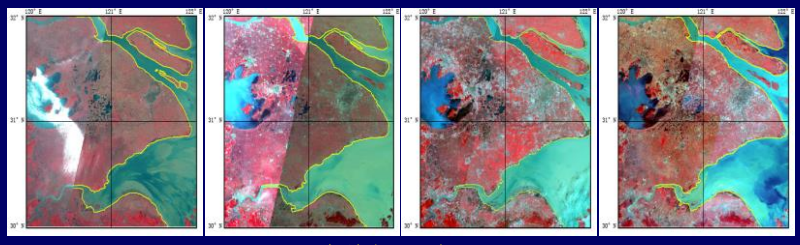
遥感调查工作分为近岸遥感和海域遥感两部分：

近岸遥感是指直接通过卫星遥感图像的判读来研究近岸区域地形地貌特征的遥感技术。

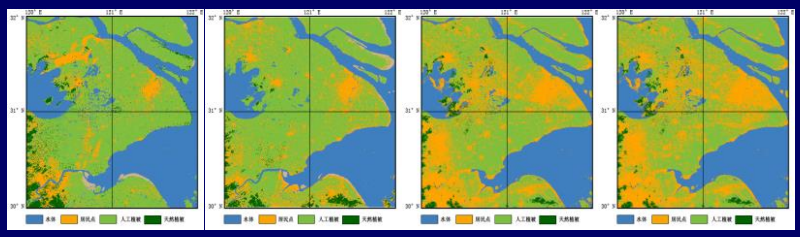
海域卫星遥感是指通过以研究海面表层温度异常分布规律等指标，来进行油气资源远景评价的一种遥感方法。

Remote sensing——遥感调查

近岸遥感



岸线提取结果

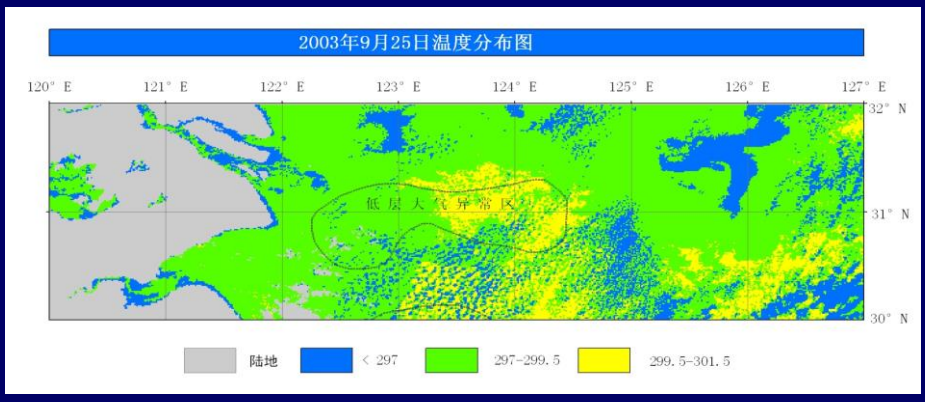


土地利用分类结果

1993年　1998年　2003年　2008年

Remote sensing——遥感调查

海域遥感



蓝色为<297K，绿色为297～299.5K，黄色为299.5～301.5K。在31.2° N，123.6° E处有异常区域，异常中心温度高出周围海域4k左右。

OUTLINE

一、 Overview

二、 Technology

三、 Main Achievement

（一）1:1M Marine geological survey

◆（1）全面提升了中国海洋基础地质调查程度，2015年历史性地完成中国管辖海域百万区调的全覆盖(fully-covered)。

（一）1:1M Marine geological survey

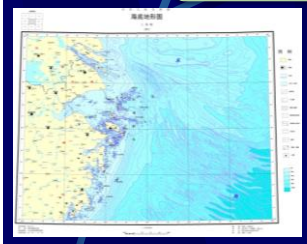
- (2)系统获取了海洋区域地质实测资料 (Data)
  基本查明了海底地形、地貌、底质、地层、构造、岩浆岩、活动断层、地球物理场等特征，为海洋地质科学研究提供了翔实基础资料。

- (3)总结了适合中国海域特点的技术方法 (Standards)
  建立了《1:100万海洋区域地质调查规范》

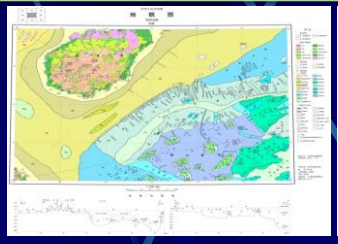
(4) 海洋区调主要成果图件(maps)

主要成果

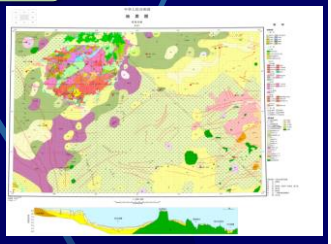
基础地质图件



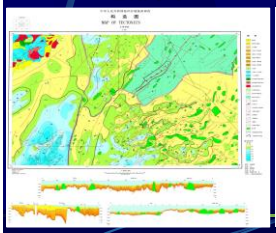
地形图



地貌图

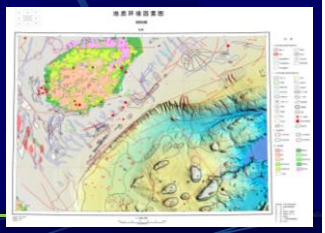


地质图



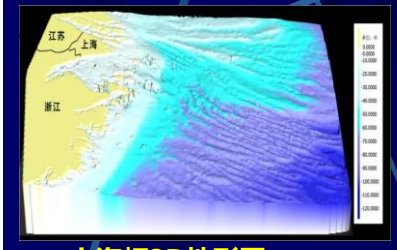
构造图

矿产图

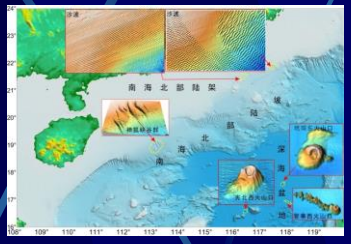


环境地质因素图

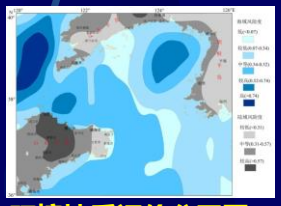
主要成果



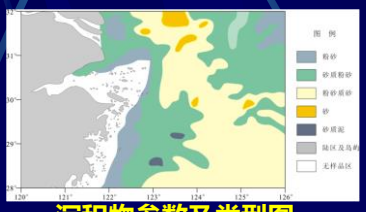
上海幅3D地形图



海底地形地貌新发现



环境地质评价分区图

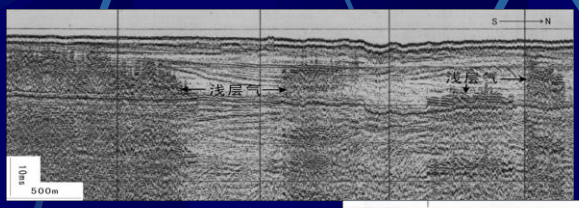


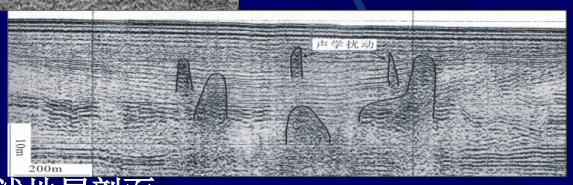
沉积物参数及类型图

海洋区调成果显著

(5)在一些关键地质问题上取得重要进展（key geological prblems）

南通幅浅地层剖面对比解释—发现了一些典型地质体

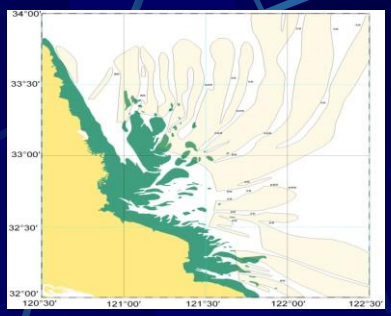




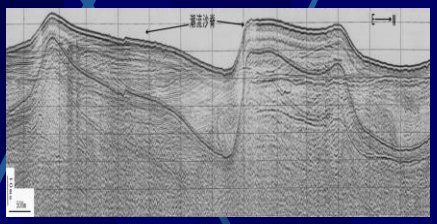
浅层气浅地层剖面

对海底工程施工具有重要的指导意义

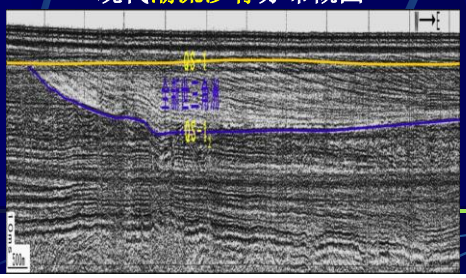
浅地层剖面对比解释—— 发现了一些典型地质体



现代潮流沙脊分布概图

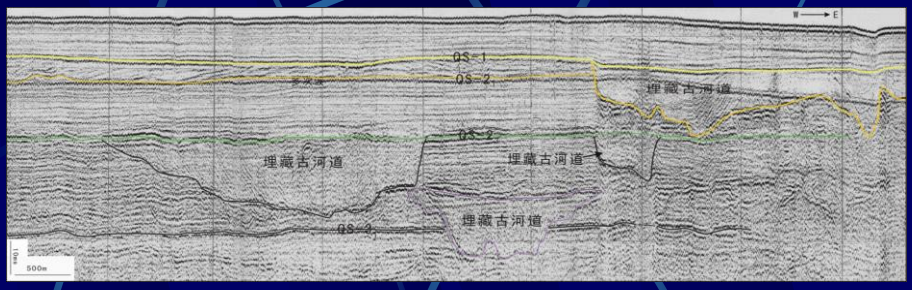


苏北浅滩区典型潮流沙脊

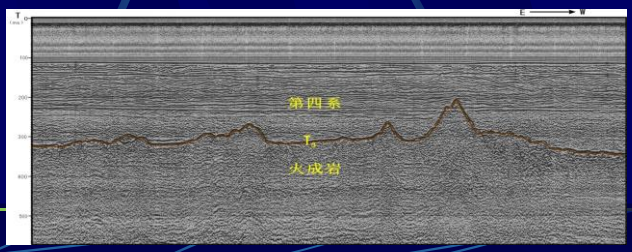


典型的全新世三角洲剖面

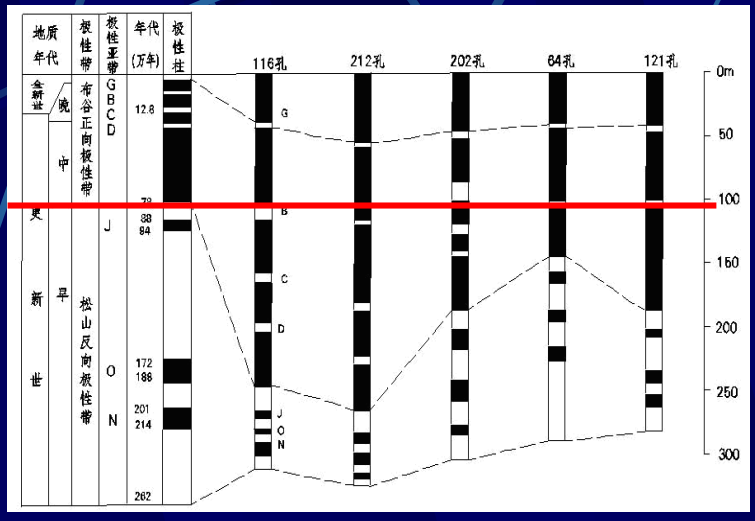
古河道--寻找海底淡水



典型的火成岩



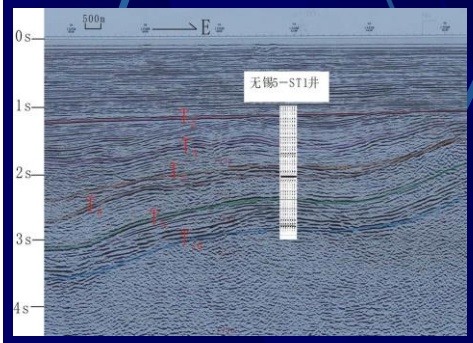
第四纪地磁倒转事件和沉积间断

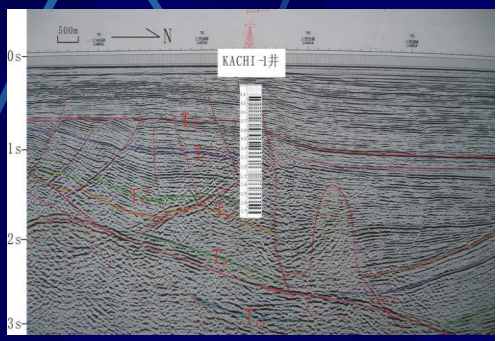


江苏沿海地区 不同钻孔第四纪磁性地层对比

(6) 亮点成果：

获取南黄海隆起区海相地层的内幕反射特征资料，开拓了南黄海找油的新领域，区调作用明显。

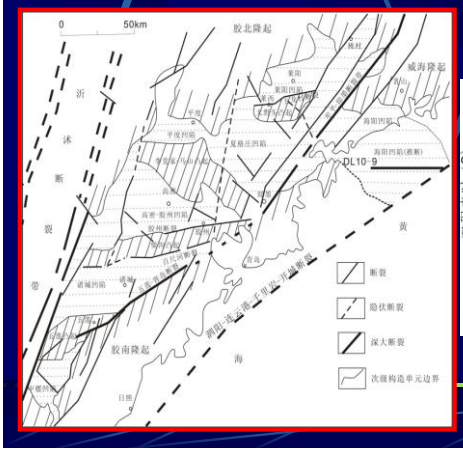


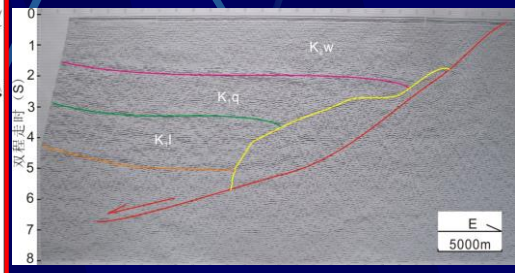


无锡5-ST1井合成地震记录图　KACHI-1井合成地震记录图

亮点成果：

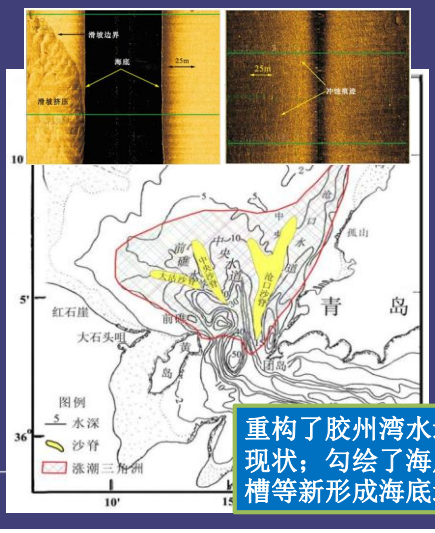
发现胶东半岛陆域的胶莱盆地海阳凹陷在南黄海有较大规模的延伸。对胶莱盆地的分布范围、形成机制及油气勘探前景取得新的重要认识。

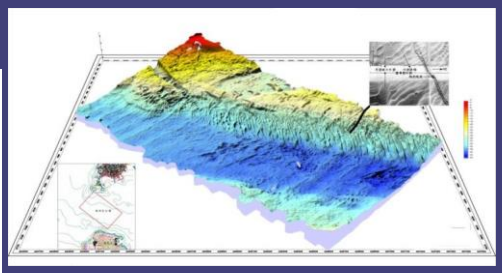


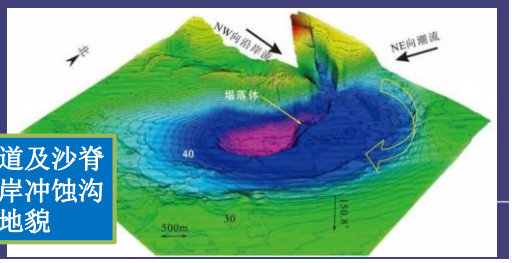


（二） Marine geological survey (1:250 000)

完成试点图幅意义重大 (Pilot map sheet)

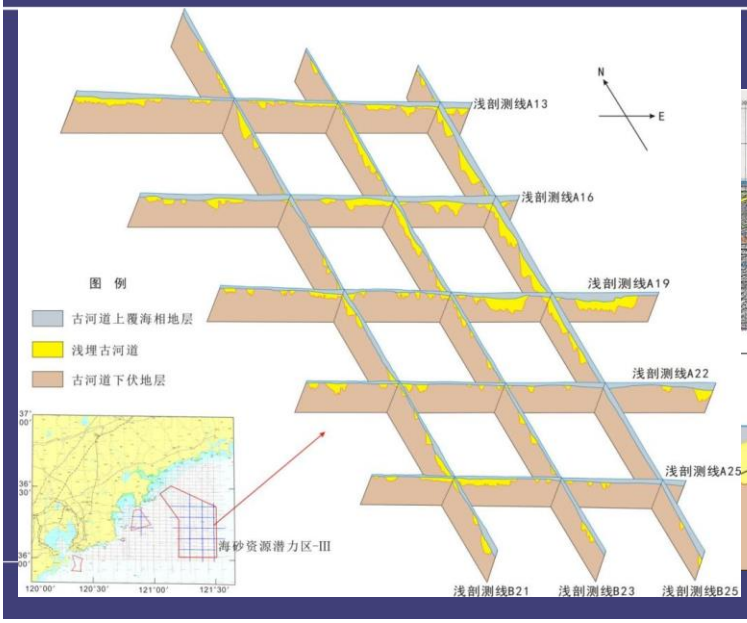


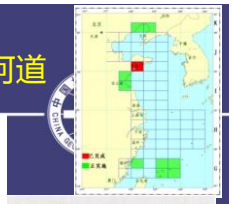


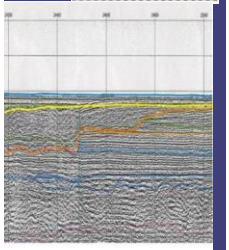


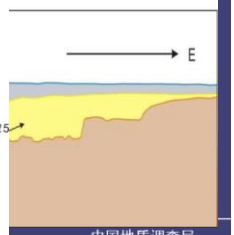
重构了胶州湾水道及沙脊现状；勾绘了海岸冲蚀沟槽等新形成海底地貌

1:25万海洋区调成果 ▶浅埋古河道









中国地质调查局
CHINA GEOLOGICAL SURVEY

（三）Marine geoscience map compilation

中国涉海编制了三套地学系列图件

1:500万　中国海陆地学系列图----8种图

1:300万　中国海-西太平洋地学系列图---9种图

1:100万　中国近海海域地学系列图---10种图

中国地质调查局
CHINA GEOLOGICAL SURVEY

1. 中国海陆联编地学系列图

地理底图 | 空间重力异常图 | 布格重力异常图 | 磁力异常图 | 地震层析成像图 | 莫霍面深度图 | 地质图 | 大地构造格架图 | 大地构造格架演化图

中国地质调查局
CHINA GEOLOGICAL SURVEY

1. 中国海陆联编地学系列图

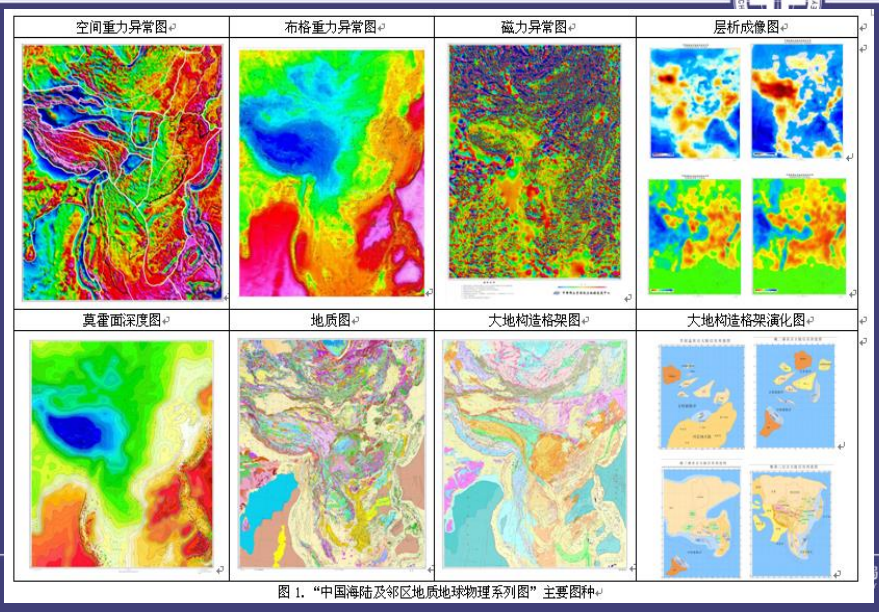
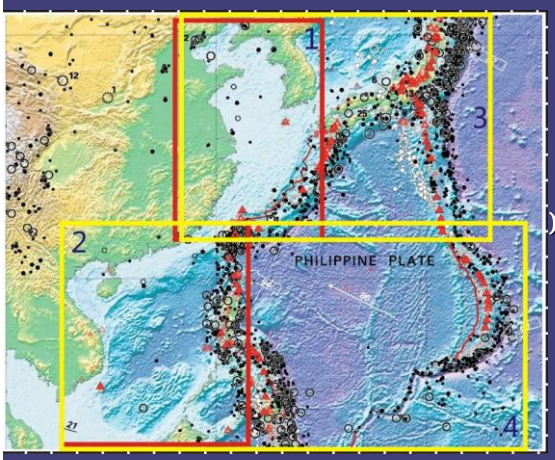


图 1. “中国海陆及邻区地质地球物理系列图”主要图种

2. 中国海域-西太平洋地学系列图

1：300万



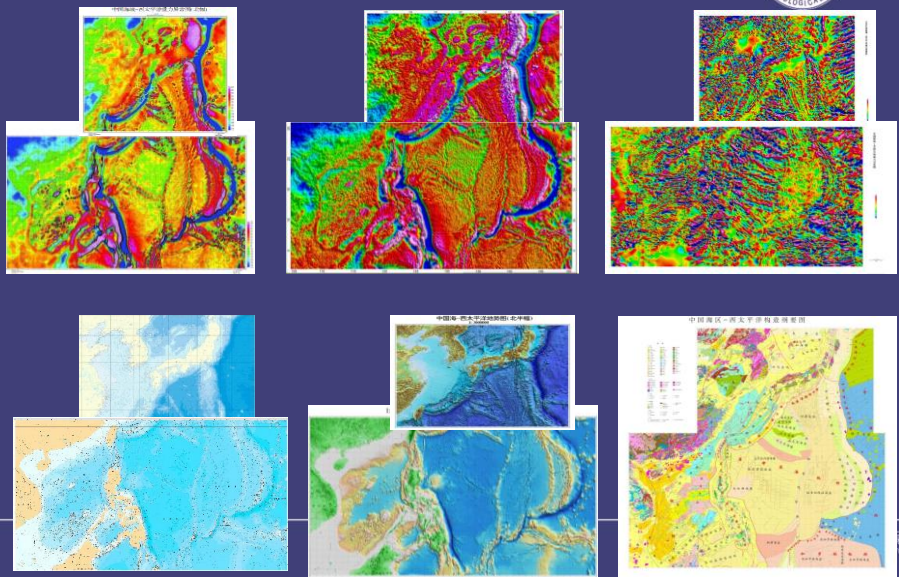
1. 水深-地形图
2. 地势图
3. 重力异常图(陆岛改

4. 布格重力异常图
5. 磁力异常图
6. 中-新生代盆地分布

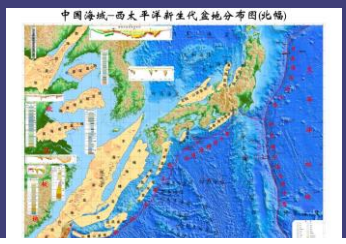
7. 构造纲要图
8. 地球动力学图
9. 典型剖面2条

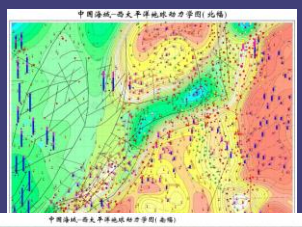
中国地质调查局
CHINA GEOLOGICAL SURVEY

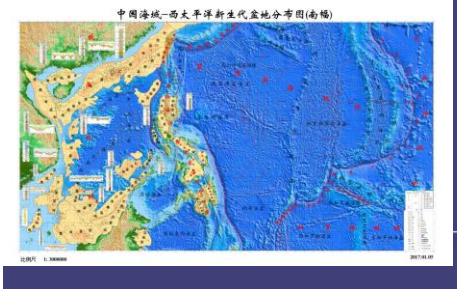
2. 中国海域-西太平洋地学系列图

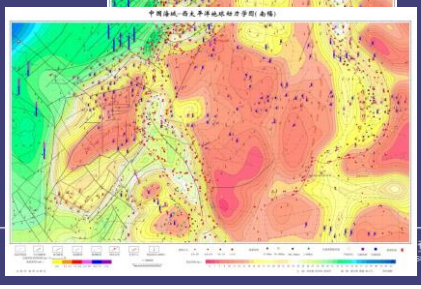


2. 中国海域-西太平洋地学系列图

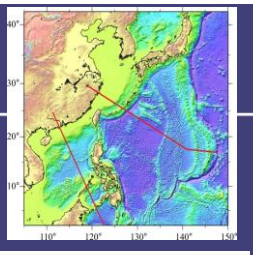


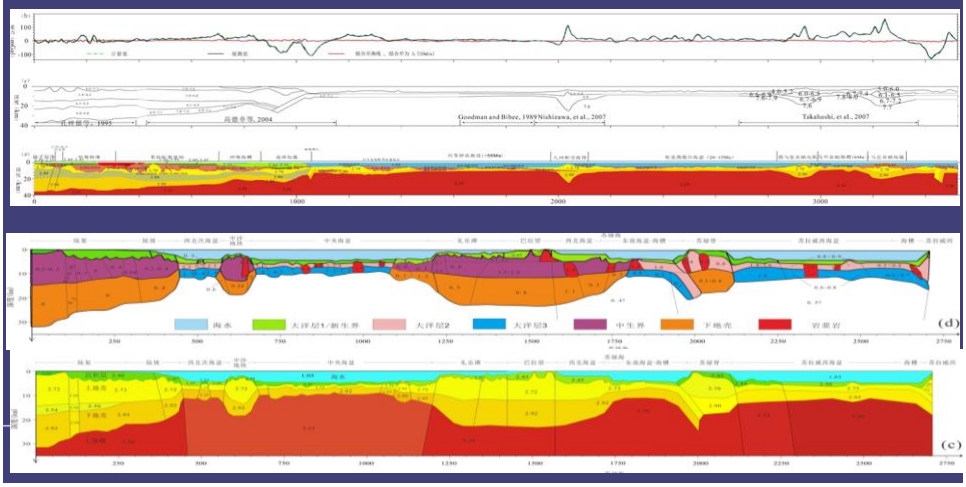




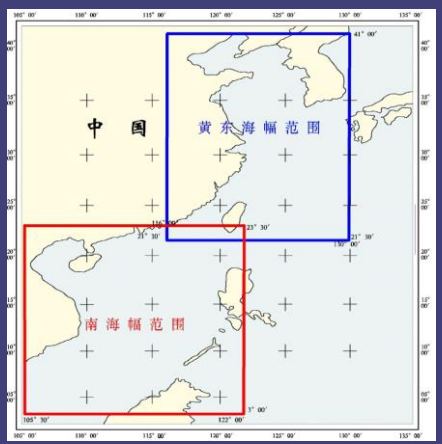


中国海域-西太平洋地学系列图





3. 中国近海海域地学系列图



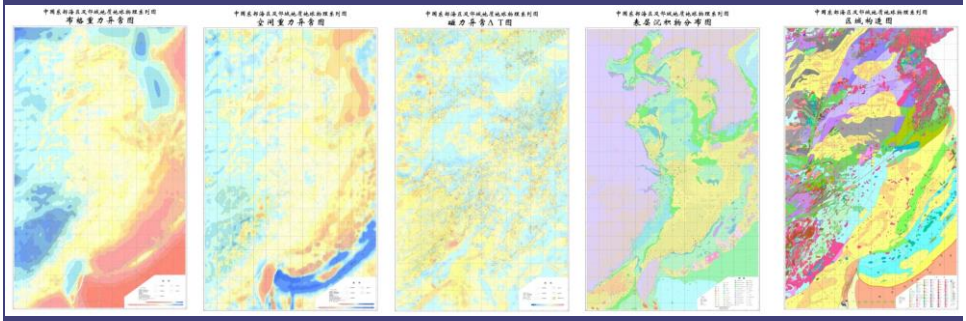
1：100万

1. 空间重力图
2. 布格重力图
3. 磁力异常图
4. 表层沉积物
5. 区域构造图
6. 水深-地形图
7. 地势图
8. 地球动力学图
9. 盆地构造图
10. 新构造地质图

中国地质调查局
CHINA GEOLOGICAL SURVEY

3.中国近海海域地学系列图

1:100万中国*东部海区*系列图(2003-2006)

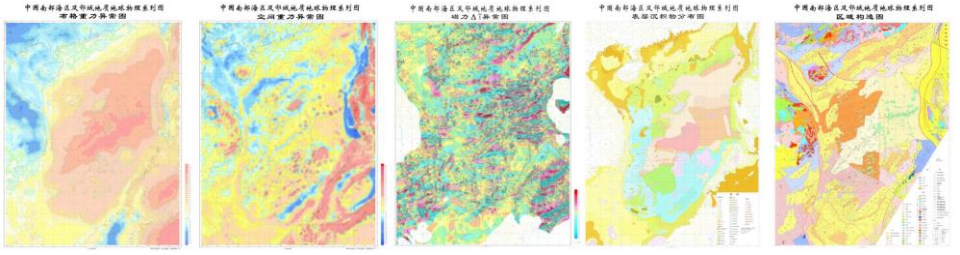


布格重力　空间重力　磁力异常　表层沉积物　区域构造

中国地质调查局
CHINA GEOLOGICAL SURVEY

3.中国近海海域地学系列图

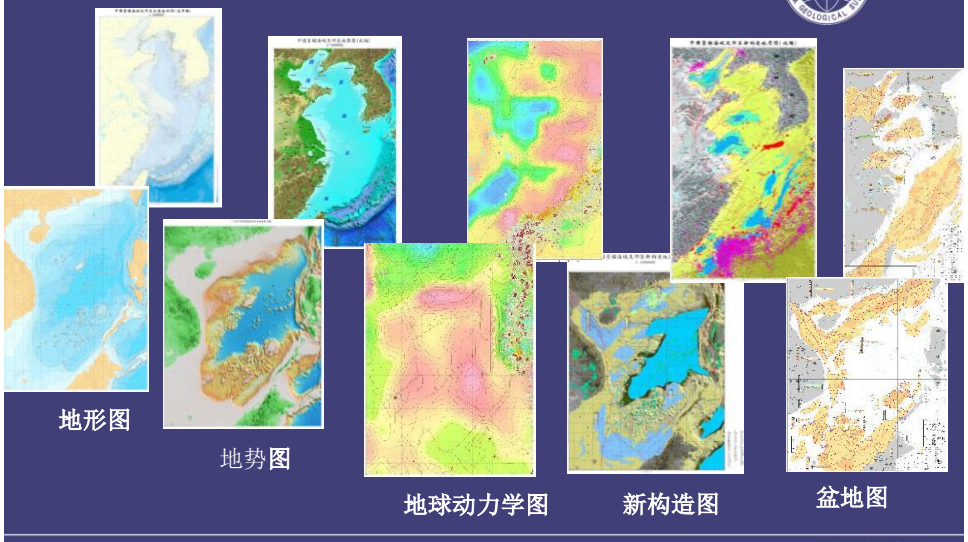
1:100万中国*南部海区*系列图(2007-2010)



布格重力　空间重力　磁力异常　表层沉积物　区域构造

中国地质调查局
CHINA GEOLOGICAL SURVEY

3.中国近海海域地学系列图



Thank you!

欢迎泰国科学家一起交流，
共同促进人类进步！

中国地质调查局
CHINA GEOLOGICAL SURVEY

China-ASEAN Compilation of Marine Geoscience Map Series

Qingdao Institute of Marine Geology，CGS

中国地质调查局
CHINA GEOLOGICAL SURVEY

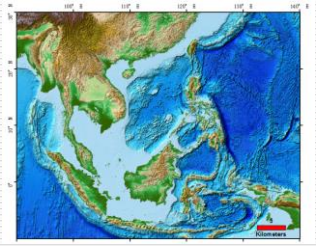
1. BACKGROUND

Background

Project:

China-ASEAN Marine Geoscience Research and Disaster Reduction and Prevention initiatives(2015-2019)

- Marine geoscience capacity building;
- Coastal Environmental Research and Disaster mitigation;
- Compilation of marine geoscience map series
- Deep structure of the China-ASEAN area research;



Study Area

China-ASEAN Compilation of Marine Geoscience Map Series

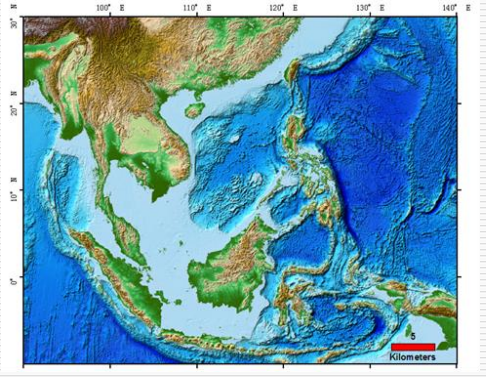
Study area：

East-West： from the Bengal Bay to the Philippines Sea

South-North：from the south China to Indonesia

90° E-140° E
10° S-30° N

Scale：1:5，000，000；
Coordinate System：WGS-84；
Projection mode:
Mercator projection
Central latitude 10° N.



Work Content

☐ Main work

1. Marine geoscience map series compilation

This map series includes 7 thematic maps：

Joint compilation of Geoscience map series：

- **Gravity anomaly map**
- **Magnetic anomaly map**
- **Geological structure map**
- **Seismic tomography map**
- **Heat flow map**
- **Surface sediment distribution map**
- **Geodynamic map**

2. ON-GOING WORK

Hold the workshop on Marine Geoscience Capacity Building and Geohazards Reduction and Prevention of China-ASEAN-CCOP:A Training seminar in Sep.2016、Aug.2017、Aug.2018

More than 100 delegates from 8 ASEAN countries and CCOP secretariat,150 from China attending the meeting

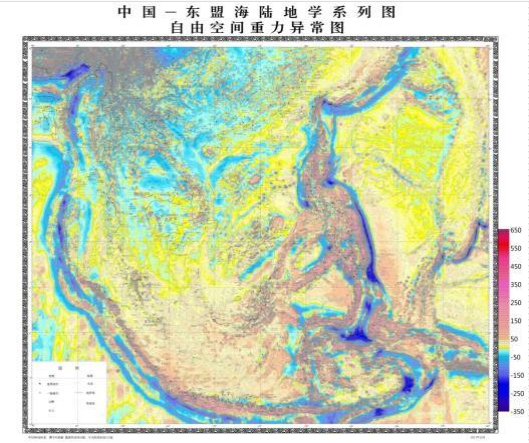
Preliminary Results

☐ Main work

☐Current Work Results

Free air gravity anomaly is the difference between the observed acceleration of free fall, or gravity, on a planet's surface, and the corresponding value predicted from a model of the planet's gravity field.

Free air gravity anomaly well correponds with the crustal structure, sedimentary basin, fault ect.



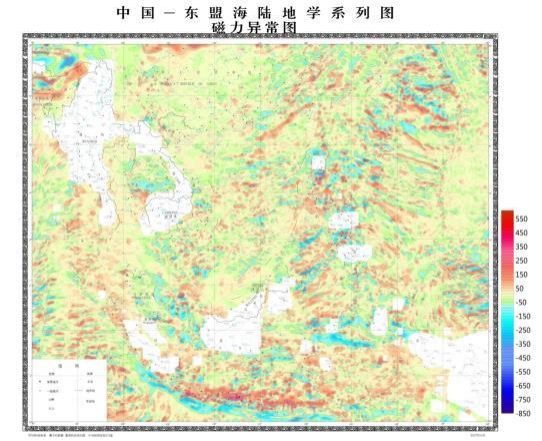
Free air gravity anomaly map

Preliminary Results

Main work

Current Work Results

Magnetic anomaly (△T) reflects the spatial distribution of different magnetic rocks in the crust, which can help identify the distribution of the submarine igneous rock and the distribution of faults and magnetic lineations



Magnetic anomaly map

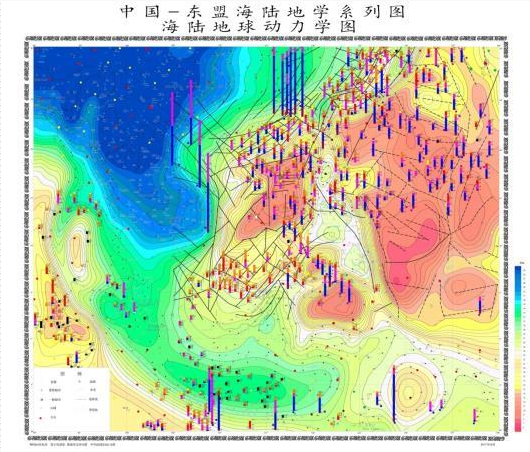
Preliminary Results

Main work

Current Work Results

On the basis of the Moho depth map, earthquake source information, deep faults, the source mechanism, the crustal velocity ect. can be revealed in the geodynamic map.

It summarizes the main geodynamic characteristics in the China - ASEAN region



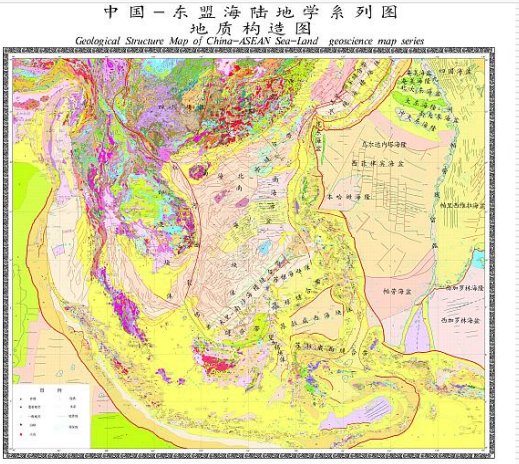
Geodynamic map

Preliminary Results

Main work

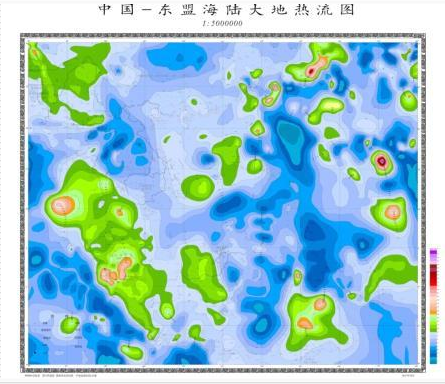
Current Work Results

Located in the conjuction zone of three plates , the study area includes many micro-blocks, such as South China block, Indo-China block etc., and developed typical trench-arc -basin systems, such as the Ryukyu trench - Ryukyu Island Arc - the Okinawa trough basin and the Sunda trench-Java island arc.



Geological structure map

Preliminary Results

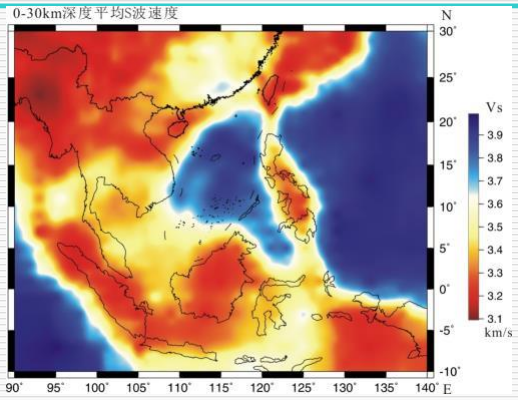


Heat flow map

Earth's surface heat flow is a fundamental output of the dynamic solid Earth's heat engine. Therefore, a better understanding of heat flow provides a constraint on the internal state of the mantle, its evolution and geochemistry.
It also provides a constraint on the thermal structure of the crust and lithospheric mantle.

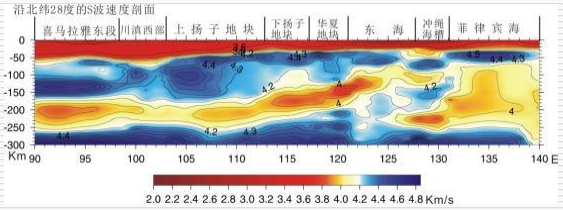
Our team intends to analyze the heat flow characteristics, to better understand the distribution of heat flow in Southeast Asia and hopefully shed light on the relationship between heat flow and hydrocarbon exploration, mineral resources, geological disasters, etc.
The distribution of heat flow in SE Asia has a good correspondence with the tectonic setting and the distribution of faults. Heat flow values are higher in the plate edges, subduction zones and deep fault zones, while low in internal plates.

Preliminary Results

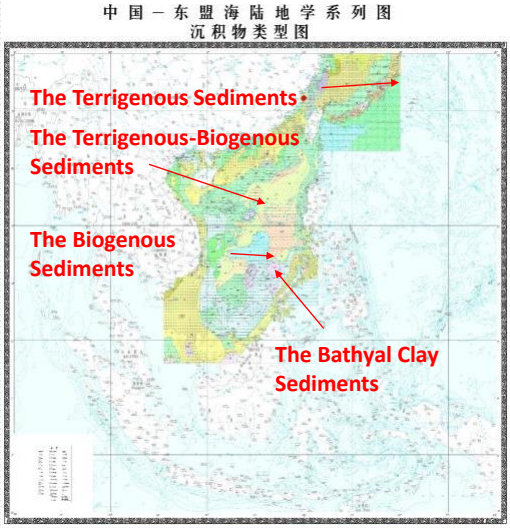


Seismic tomograhy map

0-30km S wave structure clearly reflect the continent-ocean crust distribution, and other factors(e.g sediment thickness and crustal activity)



Preliminary Results



Surface sediment distribution map

The sediment type is mainly classified on the texture, composition and formation of the marine sediments. According to the provenance of the sediments in the seas of China-ASEAN, there are four types, including the terrigenous sediments, the terrigenous-biogenous sediments, the biogenous sediments and the bathyal clay sediment.

The map of sediment type will help to understand the effect range of the terrigenous materials and the hydrodynamic environments in the different areas, and to illustrate the formation of surface sediments in the seas. It is one basic component of the geological maps.

More work need to be done
More data need to be supplemented.

Work Content

☐ Main work

2. Geoscientific research

Comprehensive study on geological and geophysical features in the Southeast Asia will be conducted during the map series compilation for better understanding of the regional geology.

For example:

- Sea surface sediment types and depositional environment
- Geotectonic framework and resources environment (disaster) effects
- Characteristics of geophysical field and its geological interpretation
- Structure and geodynamics of the lithosphere

3. Sharing research results.

Mapping results will be published as the "atlas of China - asean Marine geological (Chinese&English), for participant countries sharing the Maps.

3. COOPERATION ACTIVITY

中国地质调查局 CHINA GEOLOGICAL SURVEY

Recent cooperation proposal

2018

- **Cooperation discussion, drafting a cooperation agreement.**

2019

- **Sign the agreement, establish working group and designate a coordinator to join in the cooperation project.**
- **Invite geoscientist to visit each other (DMR、QIMG），for making suggestions to jointly compile and improve the maps.**
- **Joint field geological survey and research**
- **Hold Technical seminar.**

2020

- **Joint field geological survey and research**
- **Joint Publish 'Altas of Marine Geoscience map series'**

中国地质调查局 CHINA GEOLOGICAL SURVEY

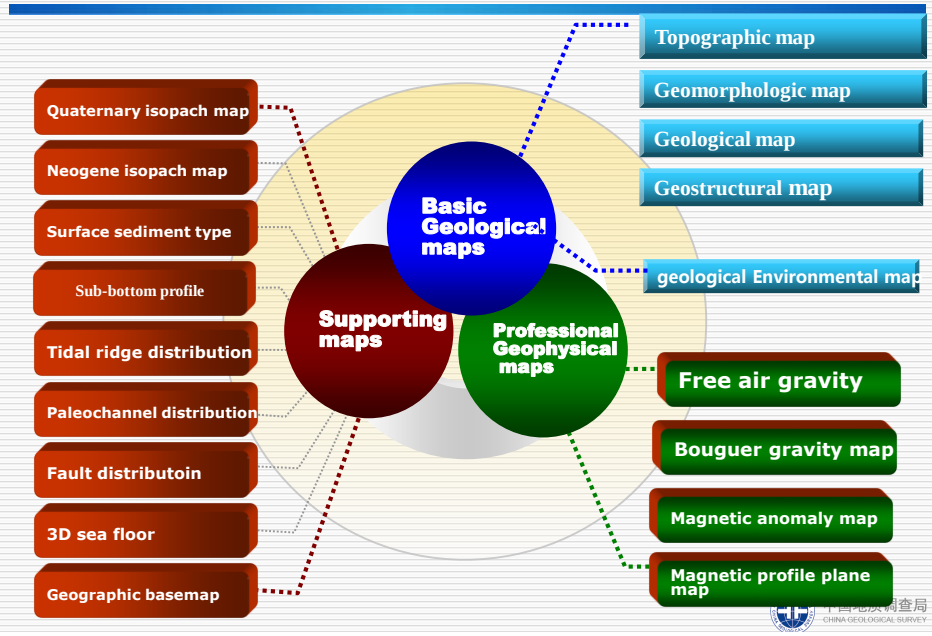
Proposal in the future cooperation-1

marine regional geology survy

Gulf of Thailand， 1:500,000 marine regional geology mapping

中国地质调查局 CHINA GEOLOGICAL SURVEY

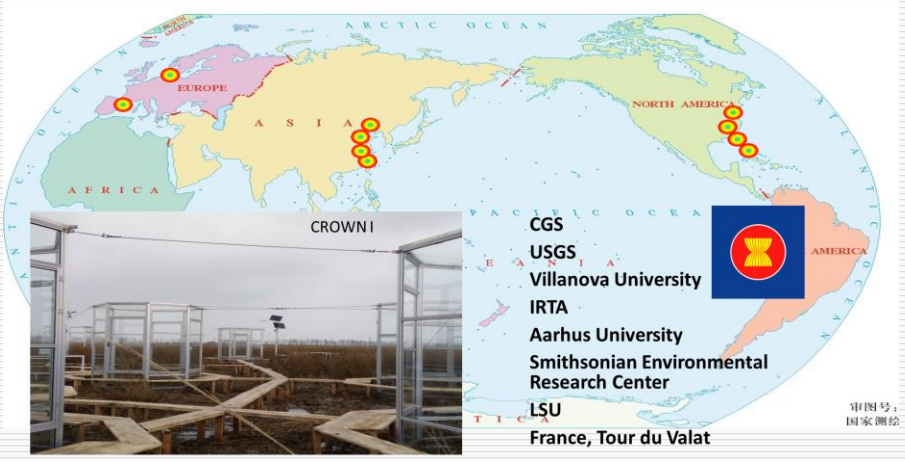
Proposal in the future cooperation-1



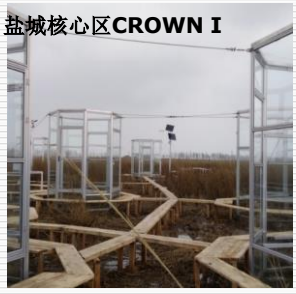
中国地质调查局 CHINA GEOLOGICAL SURVEY

Proposal in the future cooperation-2

CROWN program: Coastal-wetland Research On Warming Network



Coastal Wetland Research on Warming Network (CROWN)



Eddy covariance

Thank you!