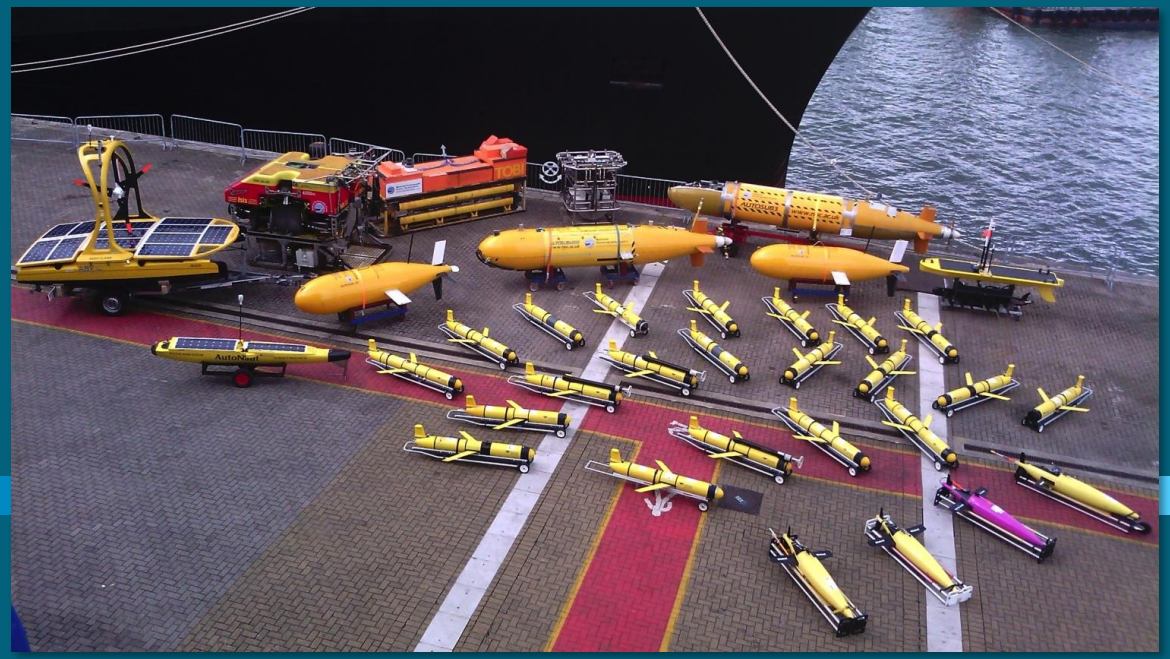
SUT
Society for Underwater Technology

水下技术学会

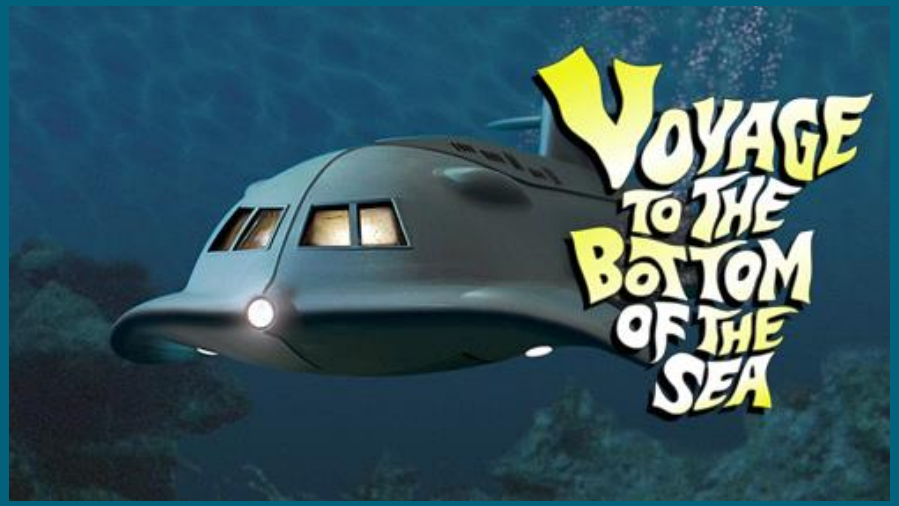


Using Autonomous Surface Vehicles to support deep sea mining activities

利用自主地面车辆支持深海采矿活动

Stephen Hall CMarSci FIMarEST Chief Executive SUT

Hello ☺ 你好


VOYAGE TO THE BOTTOM OF THE SEA


4
THUNDERBIRD
4


stereo
ORIGINAL MOTION PICTURE SOUND TRACK
007
THUNDERBALL
MUSIC COMPOSED,
ARRANGED AND CONDUCTED BY
JOHN BARRY
TITLE SONG SUNG BY
TOM JONES
UNITED ARTISTS

Who are SUT?

水下技术协会成立于 1966年, 在8个国家设有分支机构, 包括中国

SUT was established in 1966, and we have branches in 8 countries, including China.

我们的存在是为了促进和支持水下技术的科学、勘探和工业。

We exist to promote and support underwater technology for science, exploration and industry.

Who are SUT?

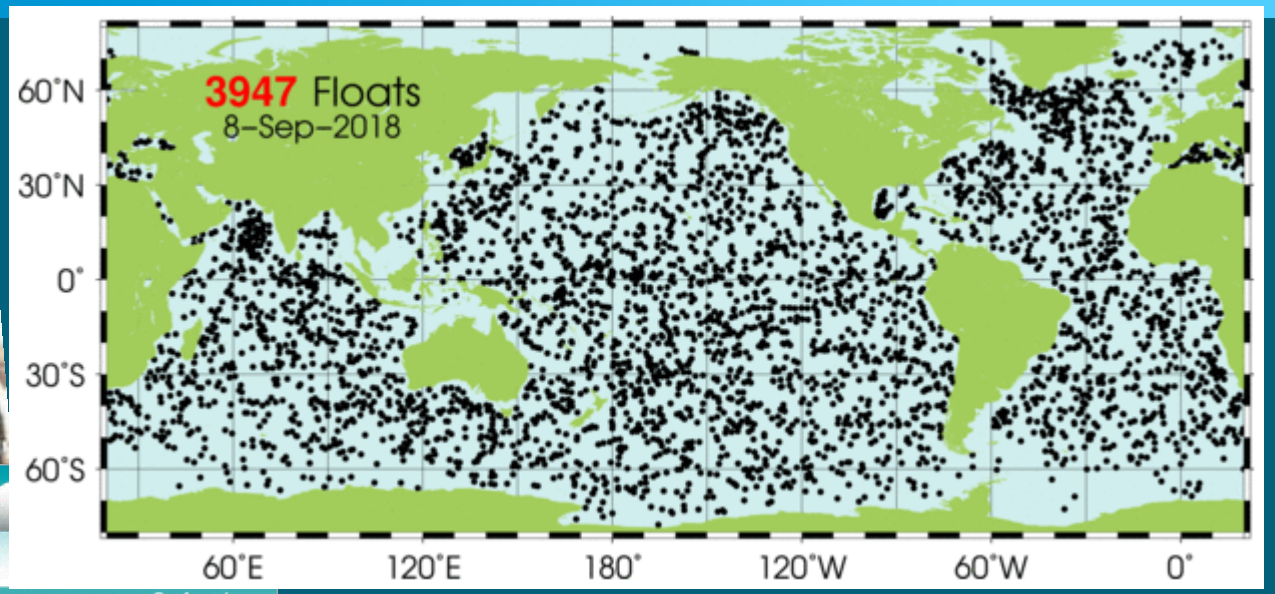
- 会员来自技术制造商和仪器制造商、海洋考古、海洋学、海军、电视电影、大学和研究院部门。
- 越来越多的政策, 法律和保险成员。
- 教育下一代是非常重要的
- Membership comes from technology manufacturers & instrument makers, marine archaeology, oceanography, navy, TV & film, university, and research institute sectors.
- We have growing numbers of policy, law & insurance members.
- **Educating the next generation is very important.**

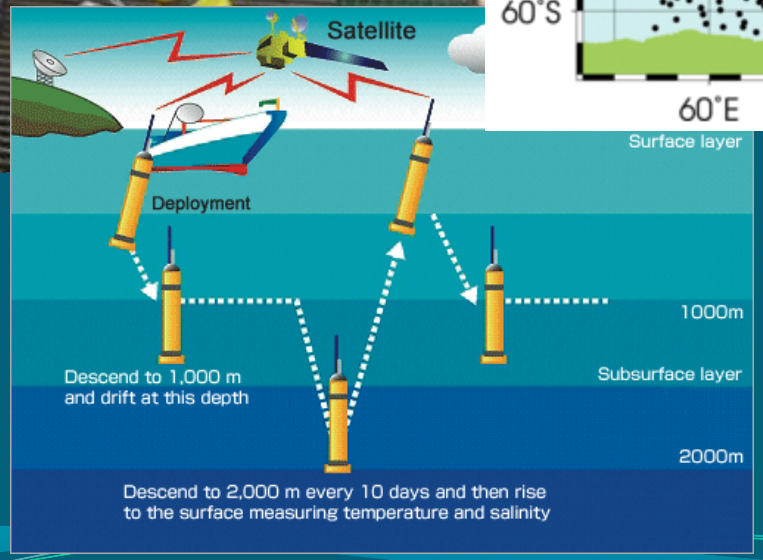
United Nations Educational, Scientific and Cultural Organization | Intergovernmental Oceanographic Commission

Robots as tools for ocean research, monitoring, surveillance and control

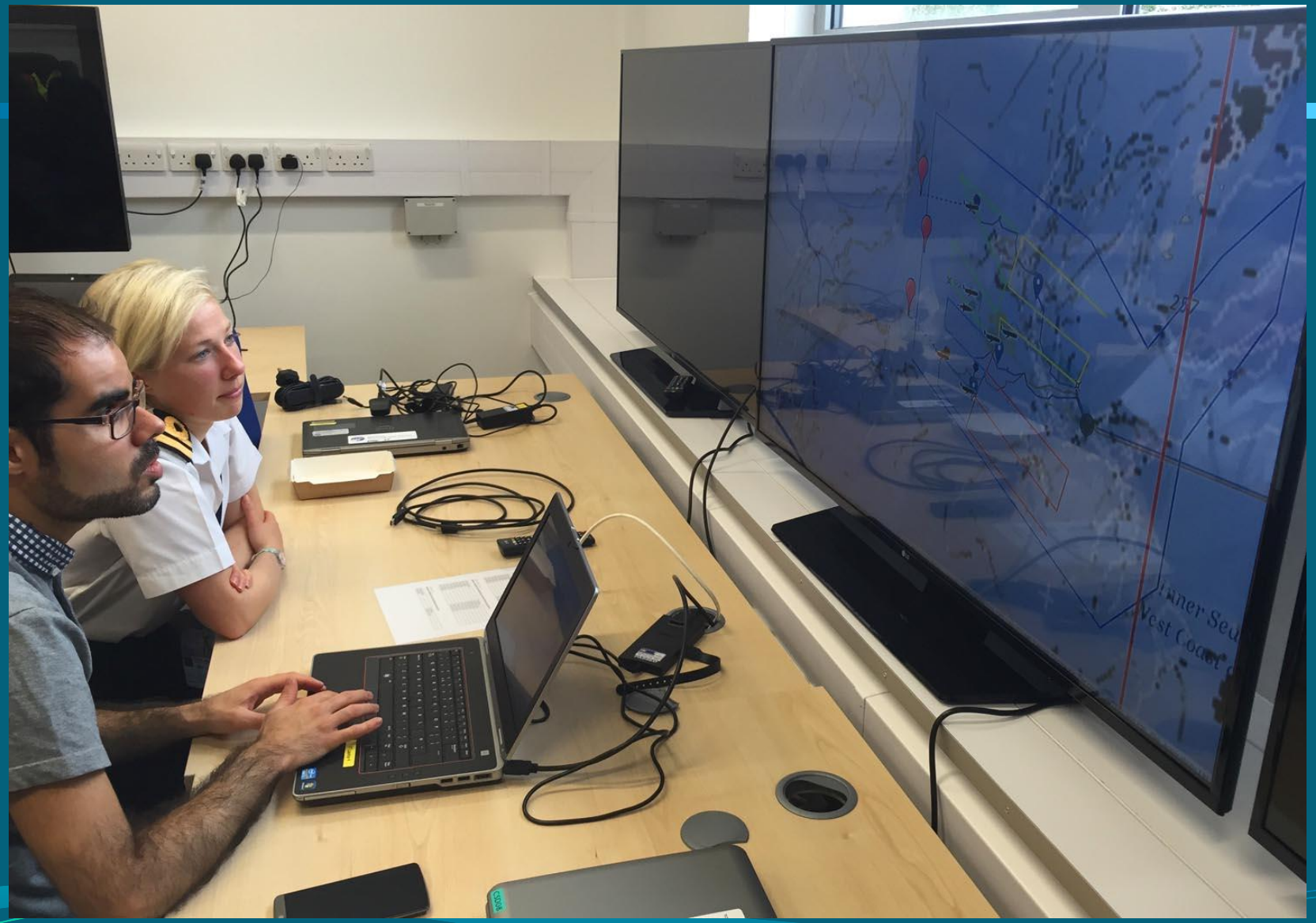
- Lower cost, high quality data for survey and surveillance.
- Ability to act as ‘force multipliers’ for crewed systems.
- Ability to go to places humans would prefer to avoid (under ice; winter storms; hostile waters).
- Stealth.
- Ever-improving reliability and intelligence.

‘Argo’ floats


3947 Floats
8-Sep-2018
60°N
30°N
0°
30°S
60°S
60°E
120°E
180°
120°W
60°W
0°


Satellite
Surface layer
Deployment
1000m
Descend to 1,000 m
and drift at this depth
Subsurface layer
2000m
Descend to 2,000 m every 10 days and then rise
to the surface measuring temperature and salinity

Royal Navy and NOC pilots in the NOC Operations Room



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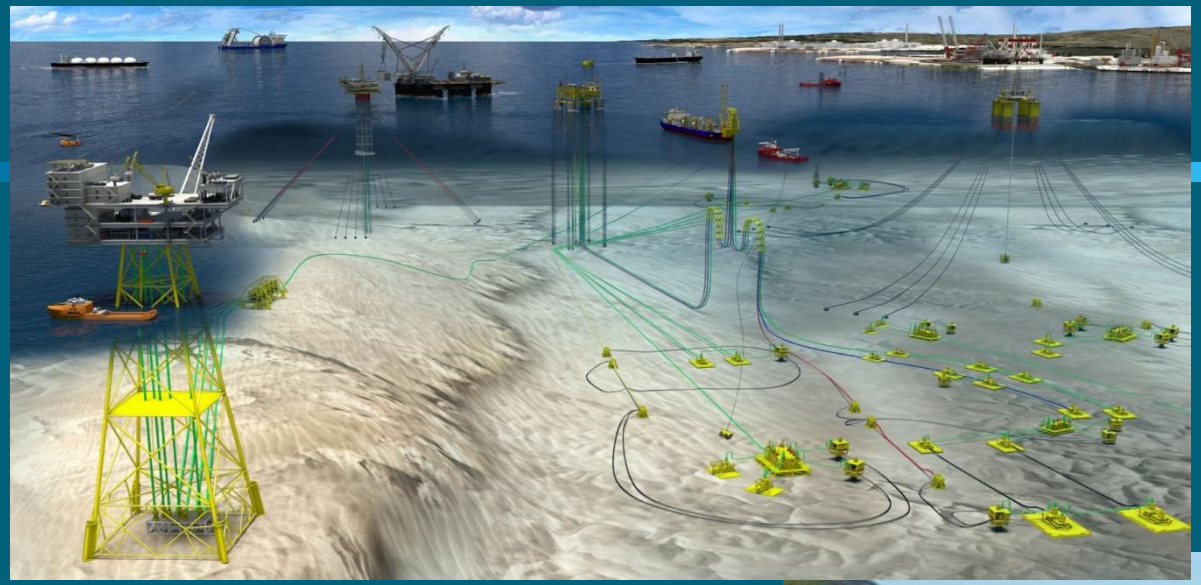
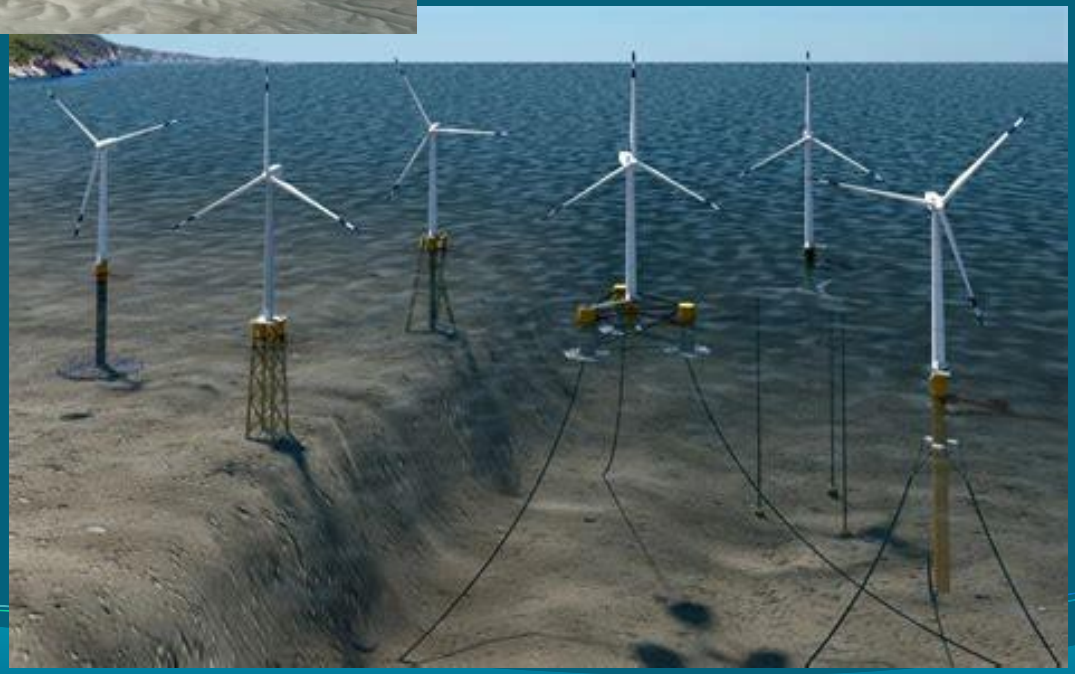
Offshore Energy





Raw Materials for a New World
为新世界而生的原料

Decarbonised Societies will require metals obtained from the ocean floor

Mining the Sea Floor

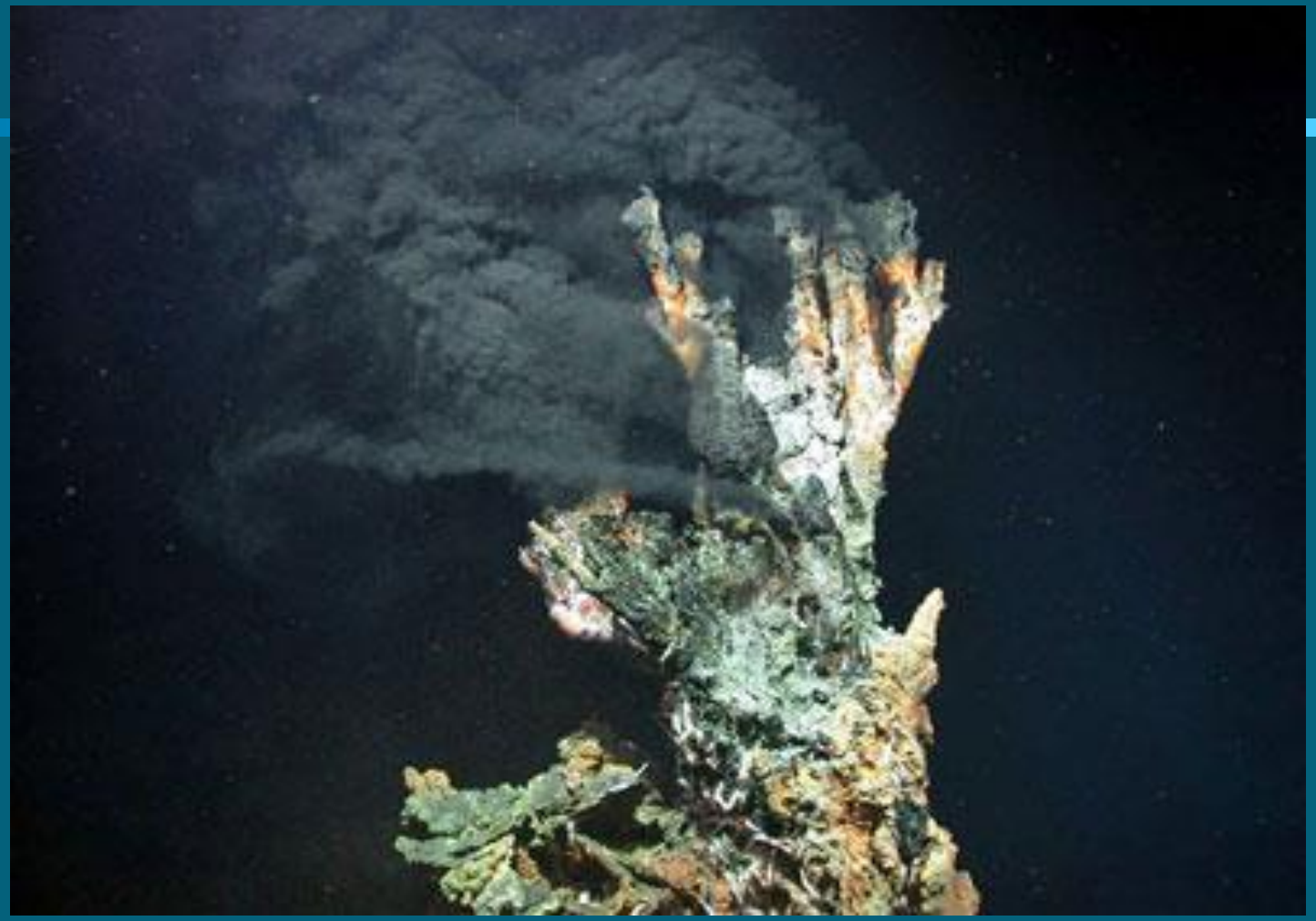
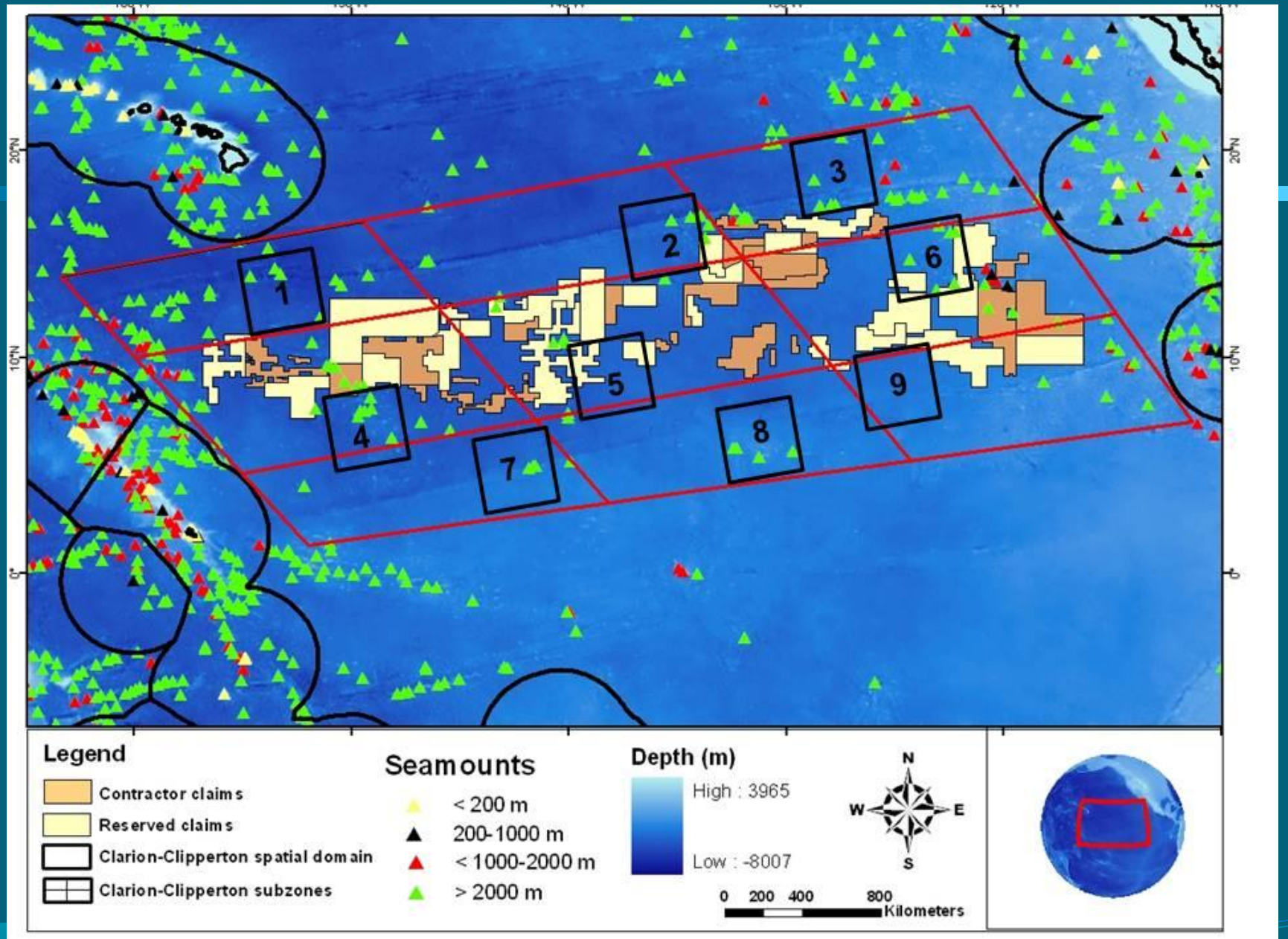


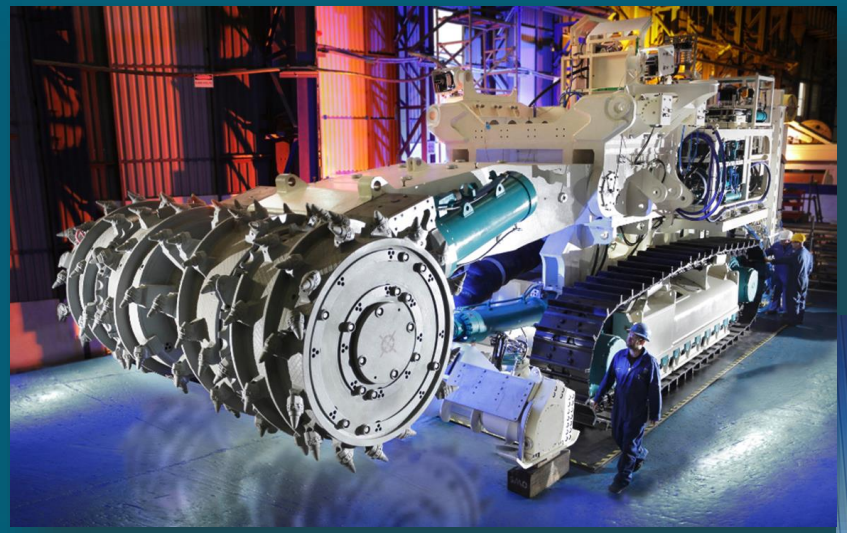
Image credit: Universität Bremen 2004


GREENLAND
(to DENMARK)
ARCTIC OCEAN
ALASKA
(to UNITED STATES)
CANADA
NORWAY
ICELAND
Hatton-Rockall
Gulf of Finland
RUSSIA
DENMARK
GERMANY
BRITAIN
IRELAND
NEWFOUNDLAND
Celtic Sea
FRANCE
Bay of Biscay
SPAIN
Aleutian islands
UNITED STATES
St Pierre & Miquelon
SOUTH KOREA
JAPAN
PACIFIC OCEAN
CHINA
East China Sea
BARBADOS
YEMEN
INDIA
TAIWAN
South China Sea
Red Sea
Mid-Atlantic Ridge
PACIFIC OCEAN
VIETNAM
PHILIPPINES
Spratly islands
MALAYSIA
MICRONESIA
SEYCHELLES
Chagos archipelago
INDONESIA
PAPUA NEW GUINEA
VANUATU
SURINAME
BRAZIL
TANZANIA
Galapagos Rift
ECUADOR
Aldabra islands
Kermadec islands
Rodrigues island
NAMIBIA
AUSTRALIA
Ascension island
SOUTH AFRICA
MAURITIUS
INDIAN OCEAN
ATLANTIC OCEAN
ARGENTINA
NEW ZEALAND
South Georgia
SOUTHERN OCEAN
Falkland islands
South Sandwich islands
Continental-shelf claims* submitted by the May 13th 2009 deadline
Areas claimed or reserved for claim
200-nautical-mile limit
Mid-ocean ridges
Trenches of the "ring of fire"
*Areas beyond 200 nautical miles
Source: National Oceanography Centre, Southampton, UK (www.noc.soton.ac.uk); The Economist

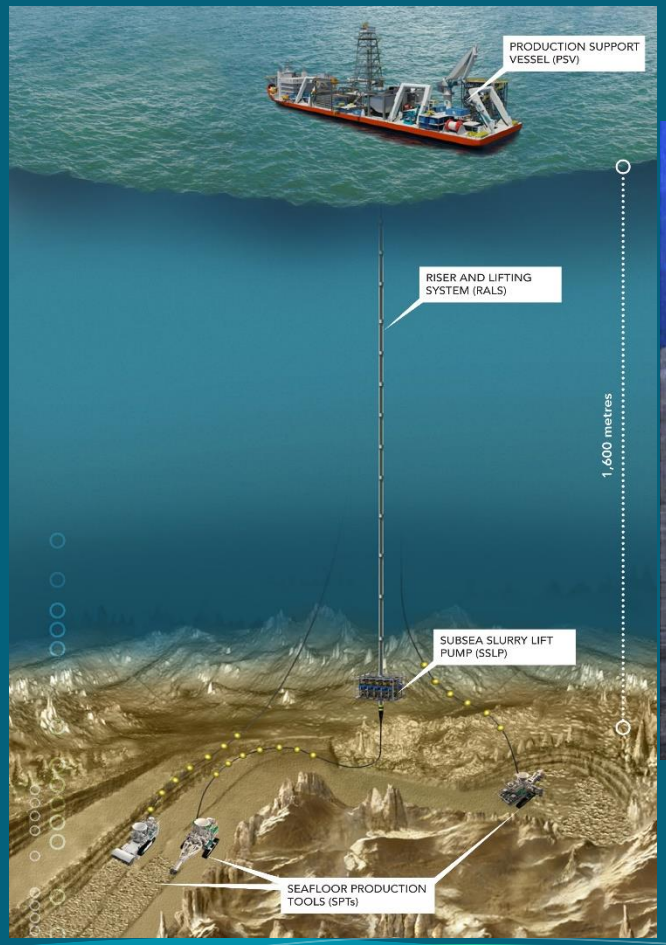


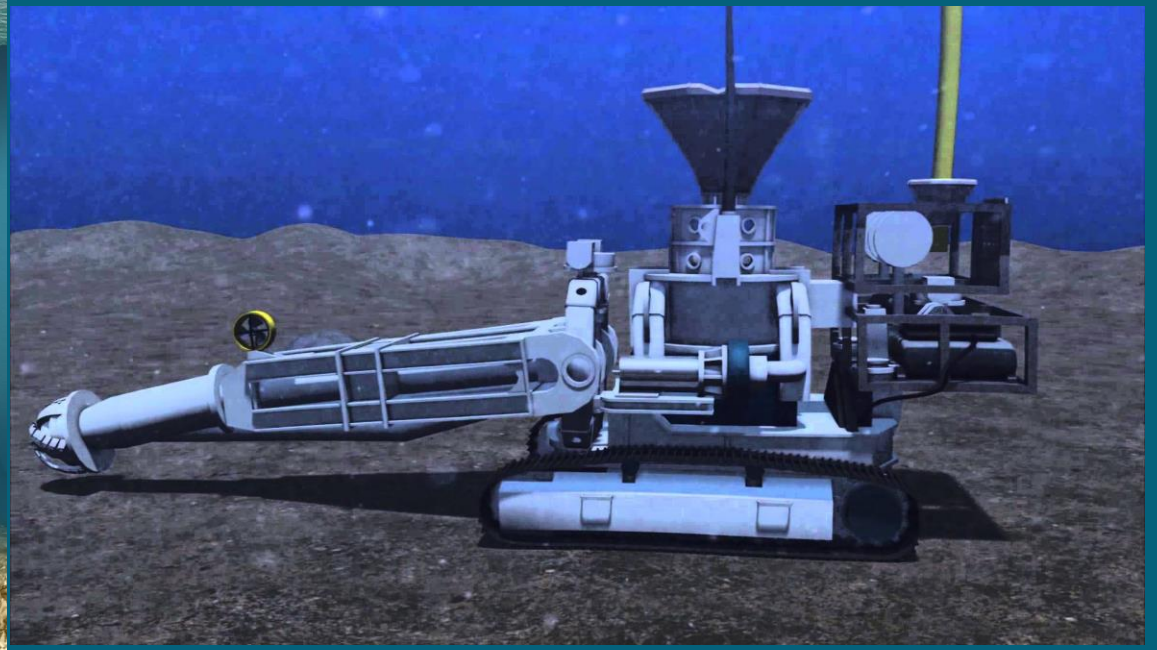
Society for Underwater Technology

New industries arising - Deep sea mining equipment – made in Newcastle, owned by China.



First Generation mining machines – connected to a ship. In the future – autonomous?





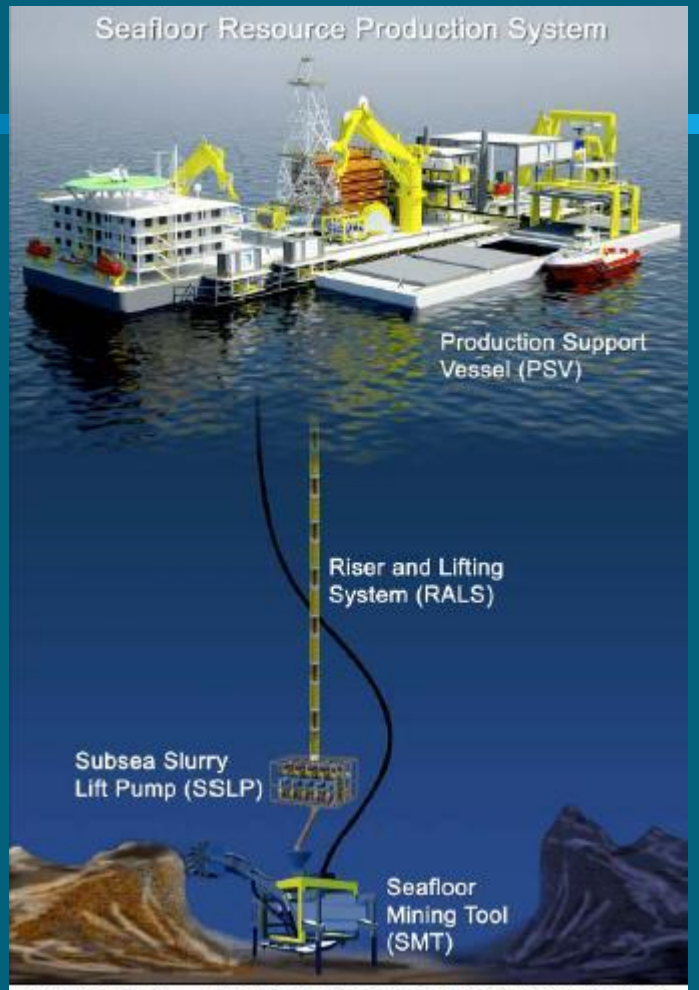
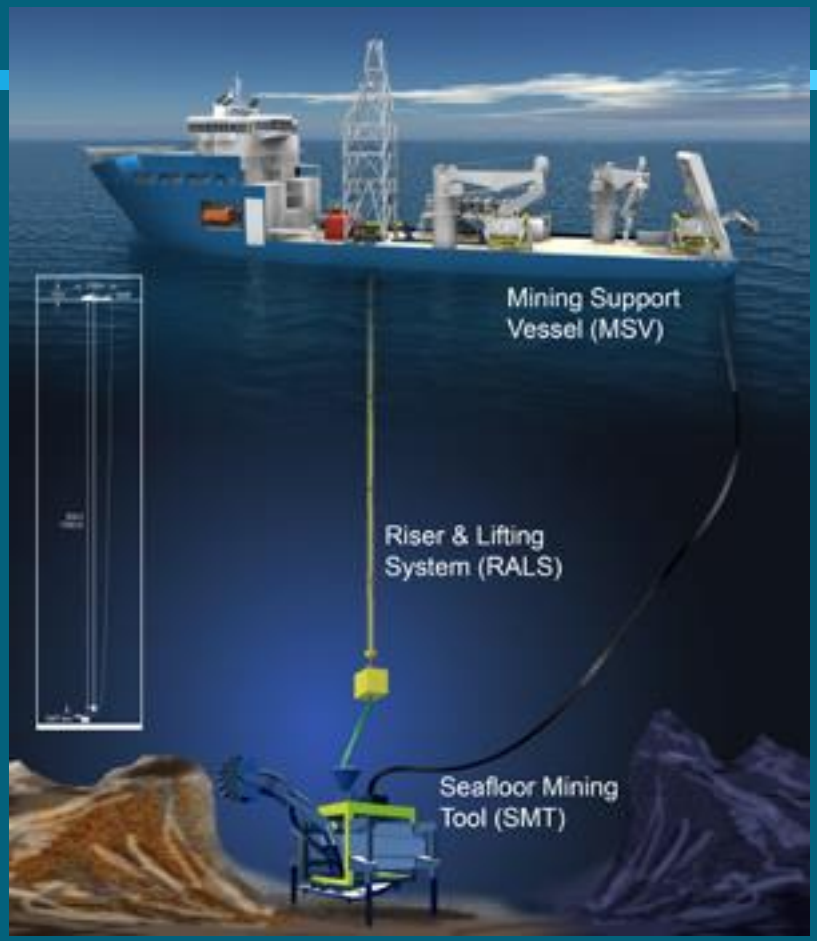


Figure 19-5: Seafloor Resource Production System



SUT as advisors to industry & governments:

The BRIDGES Project

- Marine science research
- Long-term monitoring programmes (MSFD, Copernicus)
- Living resources, marine mammals, fisheries
- Offshore industry (oil & gas, subsea mining, renewable energy)
- Maritime security

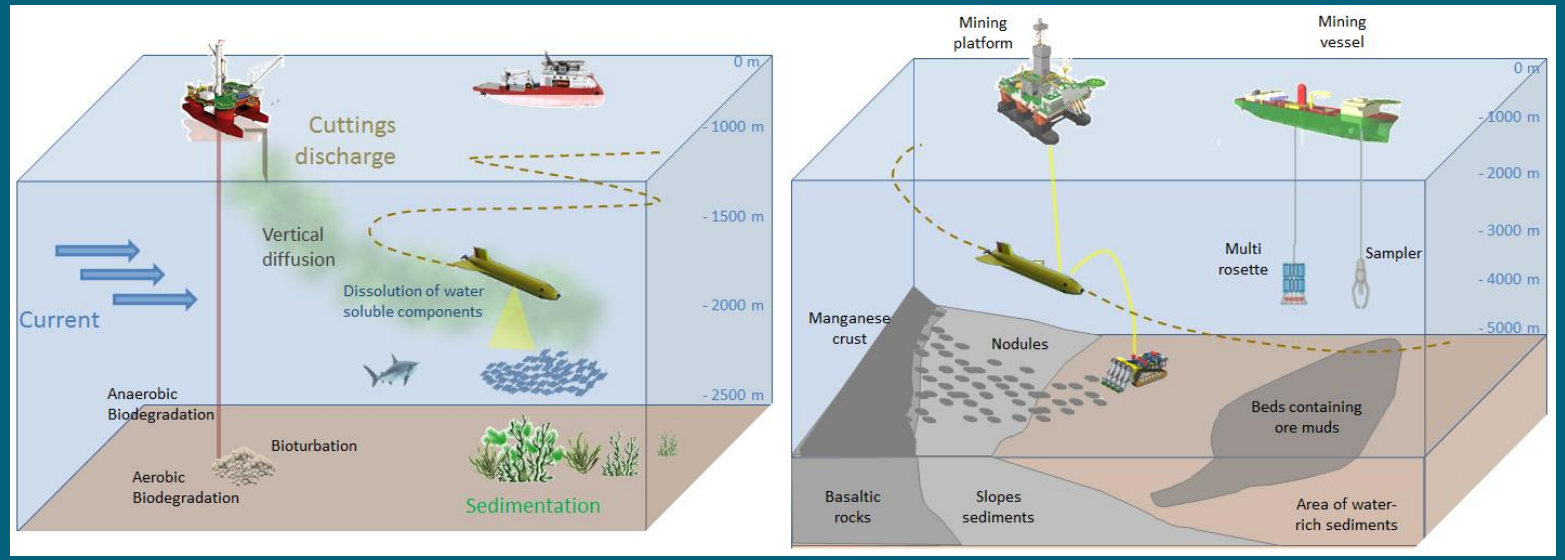
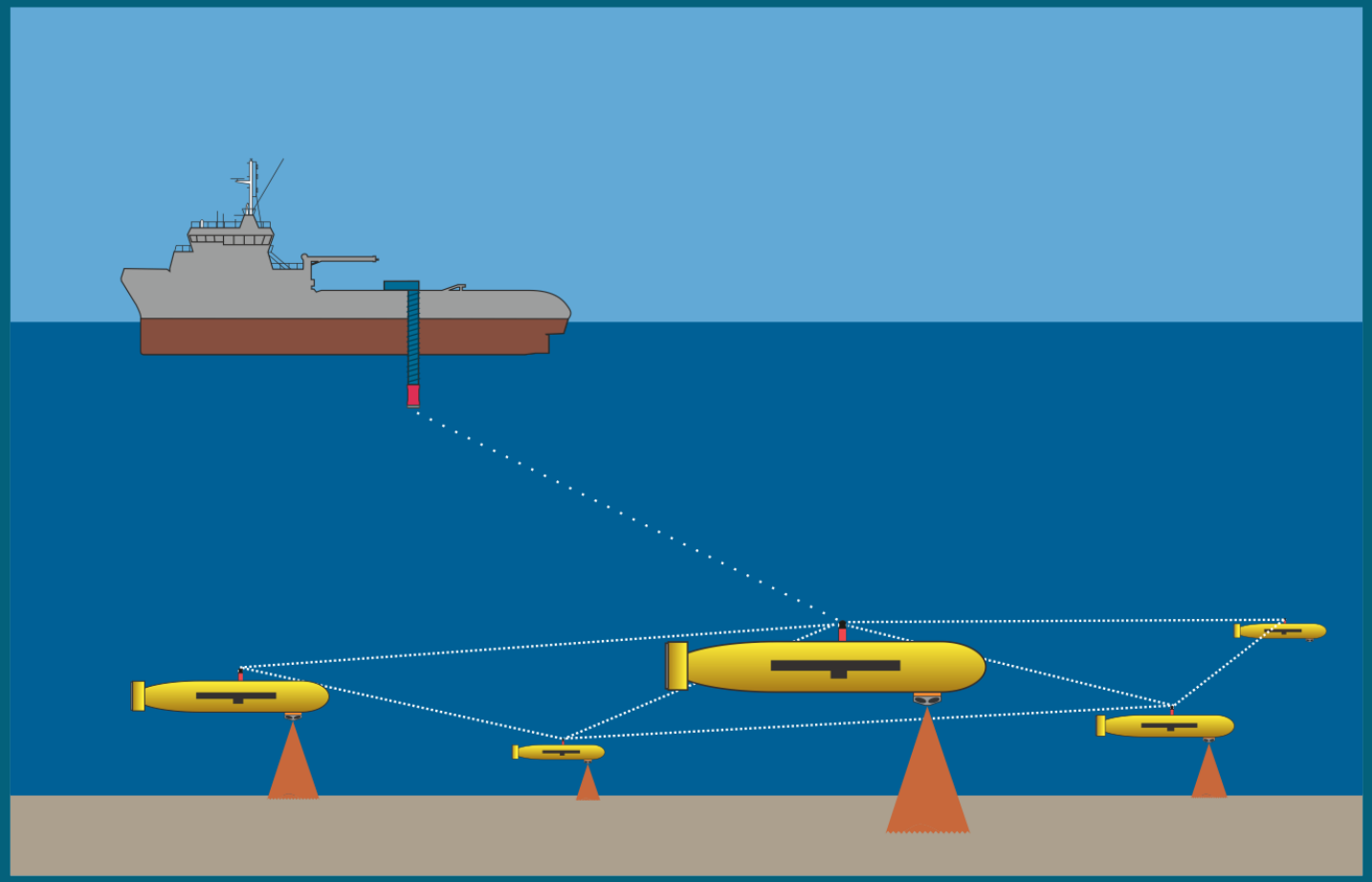
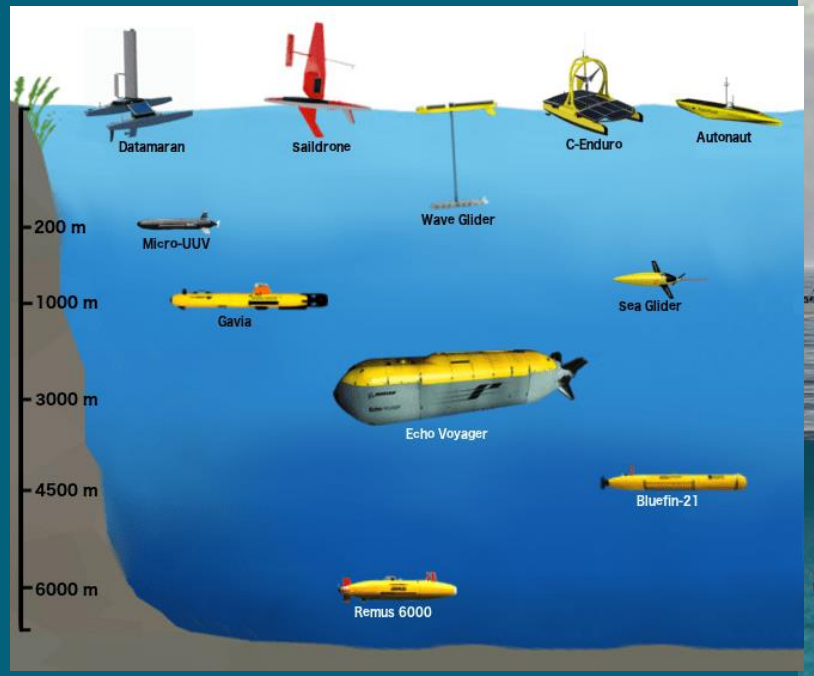


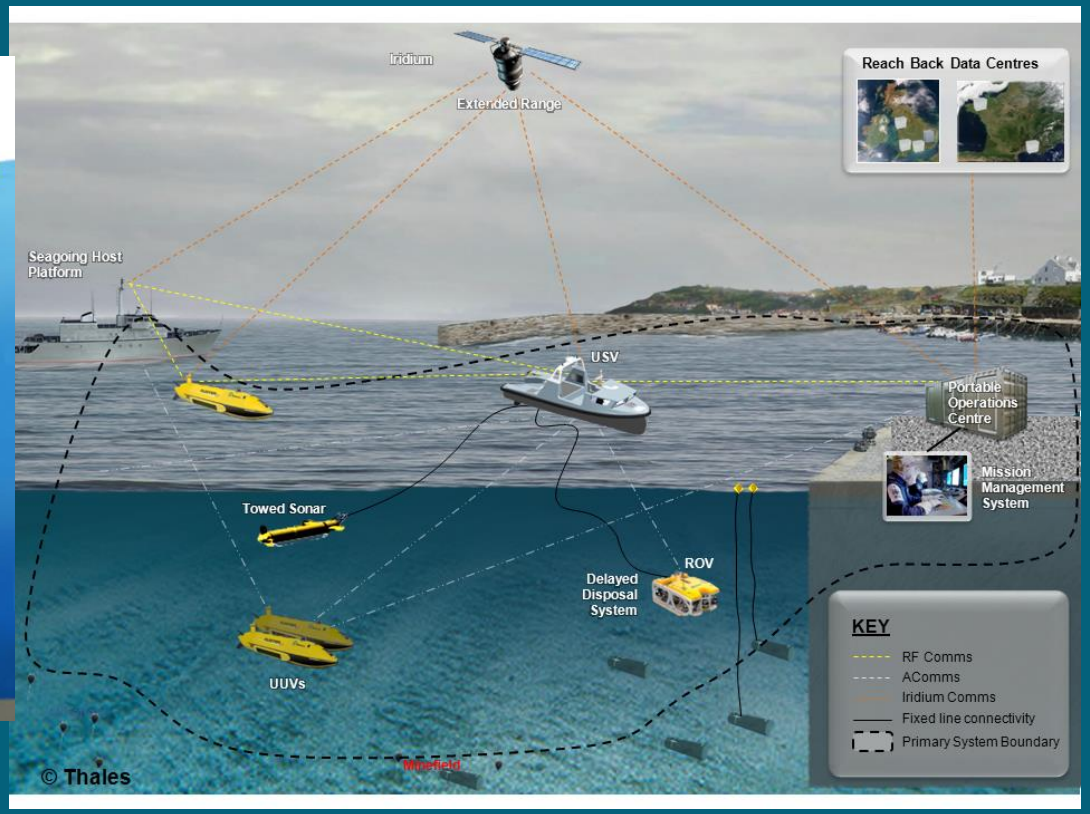
Image credit: Leighton Rolley, NOCS

AUV Swarm *Sonardyne image*



Autonomous Surface Vehicles as data relays 自动地面车辆作为数据继电器





Autonomous Surface Vehicles as data hubs 作为数据中心的自主地面车辆

Conclusion

- Autonomous Surface Vehicles allow remote operation of AUVs and mining equipment away from the ‘mother ship’.
- There are security issues to be addressed such as secure communication links and reliable navigation.
- Autonomous Surface Vehicles are suitable for use in winter and storm conditions so allow all-year working.
- 自主地面车辆允许远程操作水下机器人和采矿设备远离 "母船"。
- 有安全问题需要解决, 如安全通信链接和可靠的导航。
- 自动地面车辆适用于冬季和暴风雨条件, 因此允许全年工作。

Thank You - 谢谢

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Twitter @SUT_news
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