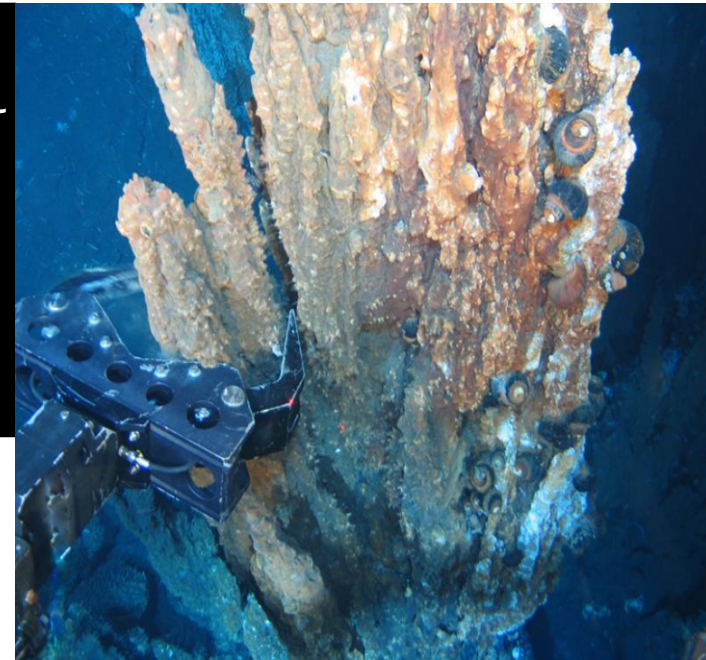


EXPLORING THE DARK

Martijn van Wijngaarden and Richard Burger, students BSC of the minor Deep Sea
present

Conquering the Deep Sea



14 March 2013

Index

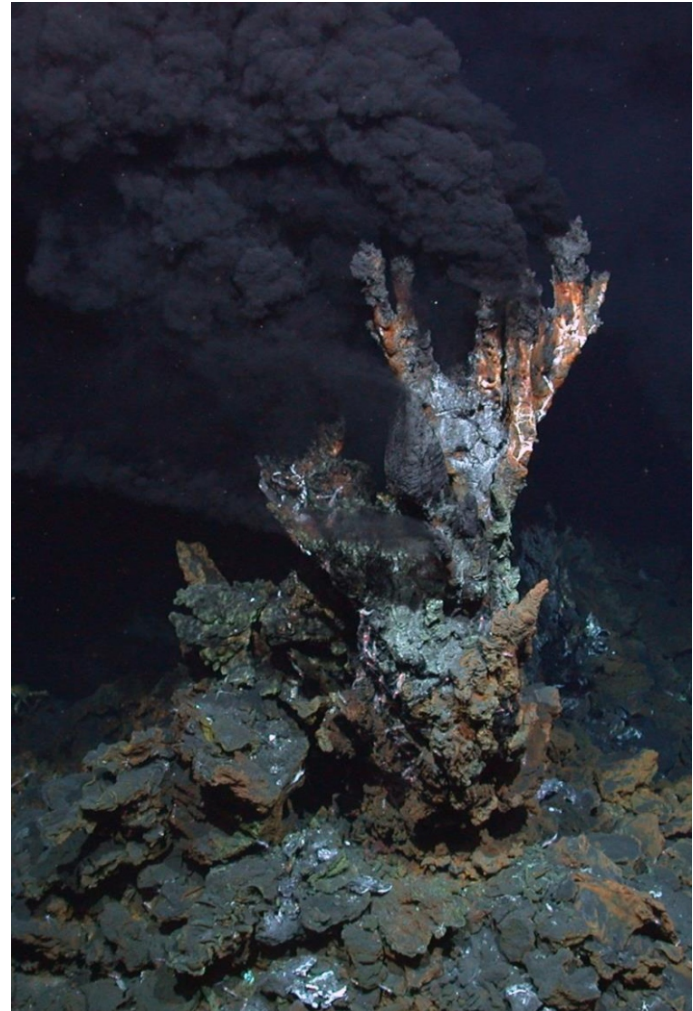
- Deep Sea Minor
- The Project
- The Design
 - Seafloor Mining Tool (SMT)
 - Vertical Transport System (VTS)
 - Mining Support Vessel (MSV)
 - Horizontal Transport System (HTS)
- Economical Evaluation
- Other Considerations

The Deep Sea Minor

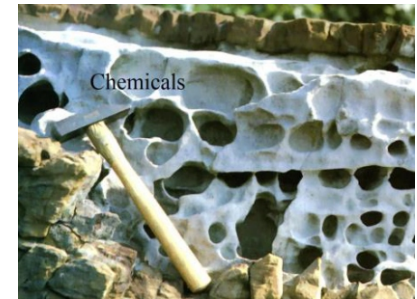
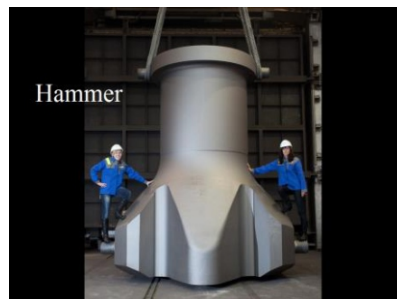
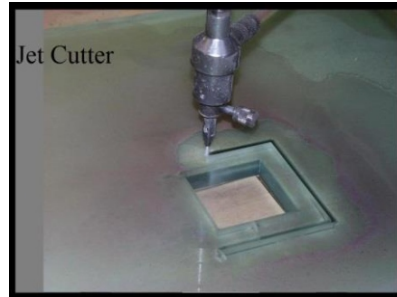
- Hot topic
- Frontline, pioneers
- Companies involved
 - Visits
 - Guest lectures

The Project

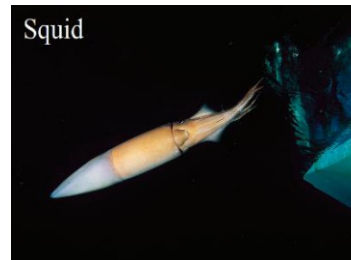
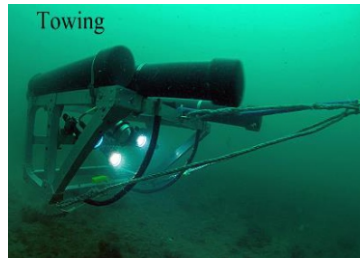
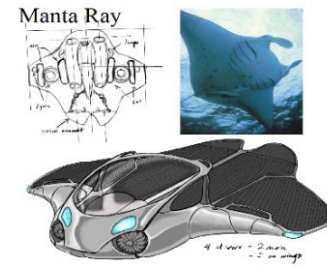
- Our project – Solwara 1 field
 - 1600 meters depth
 - High grade copper, gold and silver
 - Within Papua New Guinea Exclusive Economic Zone
- Design process
 - Ideas
 - Multi criteria analysis
 - Concept



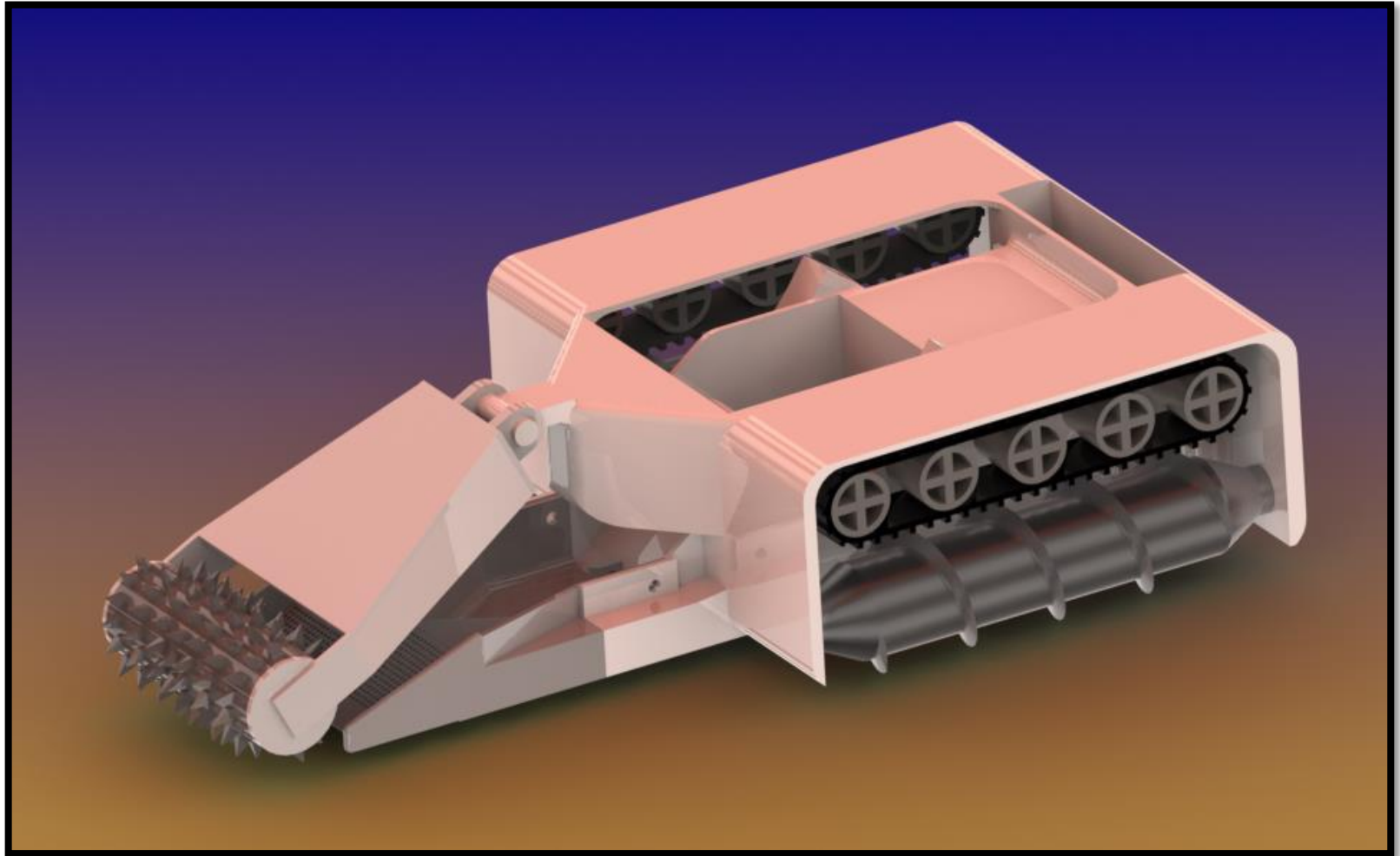
Excavation Methods



Propulsion Methods



Seafloor Mining Tool

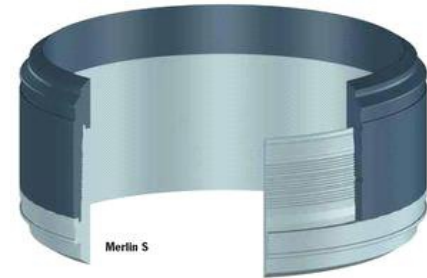


Vertical Transport System

- Design criteria
 - Power consumption
 - Efficiency
 - Technical simplicity
 - Wear
 - Corrosion
 - Maintenance
 - Fatigue
 - Feasibility
 - Durability

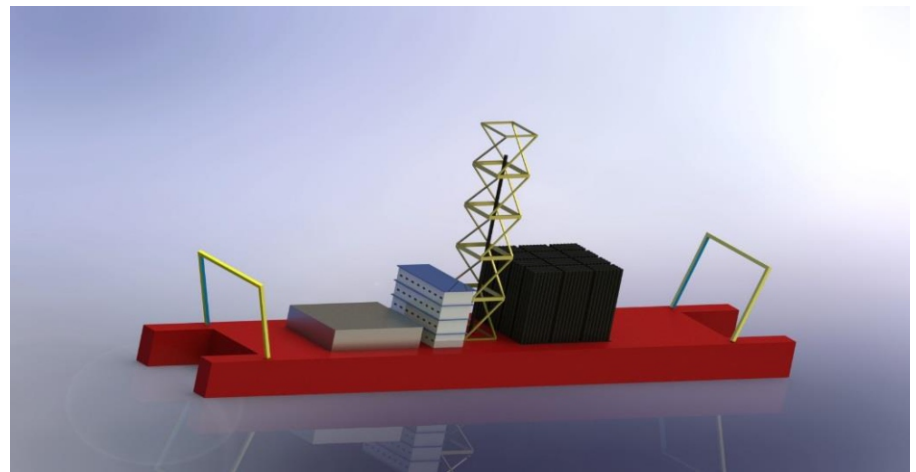
Vertical Transport System

- Main vertical riser
 - For the largest vertical distance (1.600 m.)
 - 3 Centrifugal pumps of 1,4MW
- Riser transfer pipe
 - Connects SMT to VTS (100 m.)
 - Supplied with buoyancy modules
- Material: 13-Cr steel
- Flexible connection to MSV



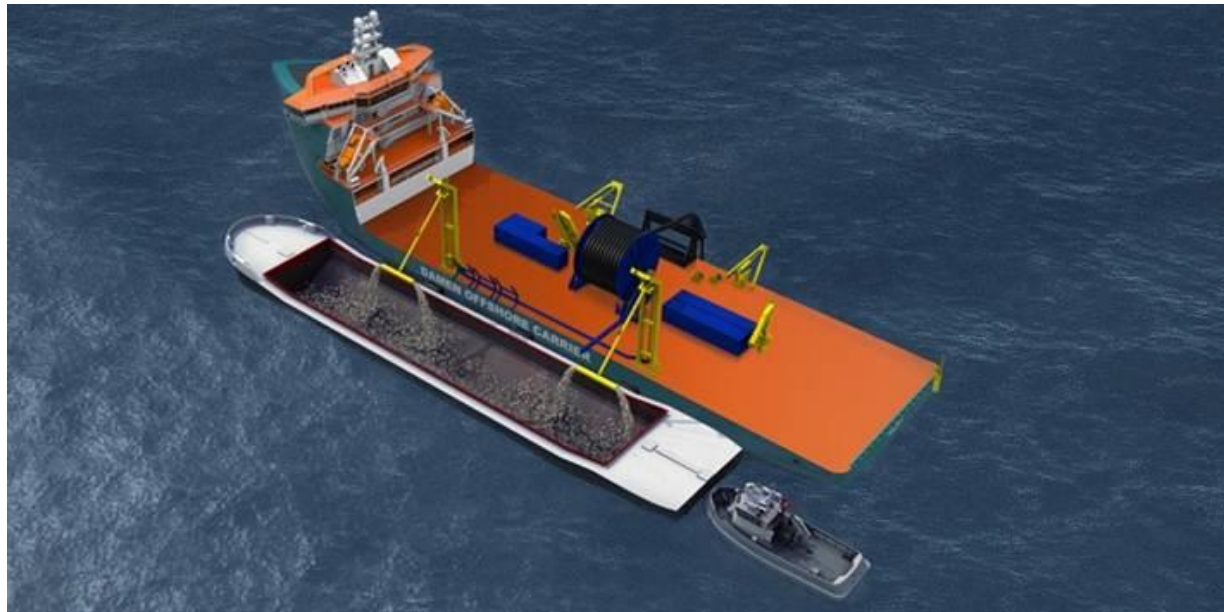
Mining Support Vessel

- Mono-hull design
- Derrick with moonpool
- Dual launch and recovery systems
- Dewatering plant
- Temporary storage facility
- Dynamic positioning system



Horizontal Transport System

- Barges
 - High Reliability
 - Low cost

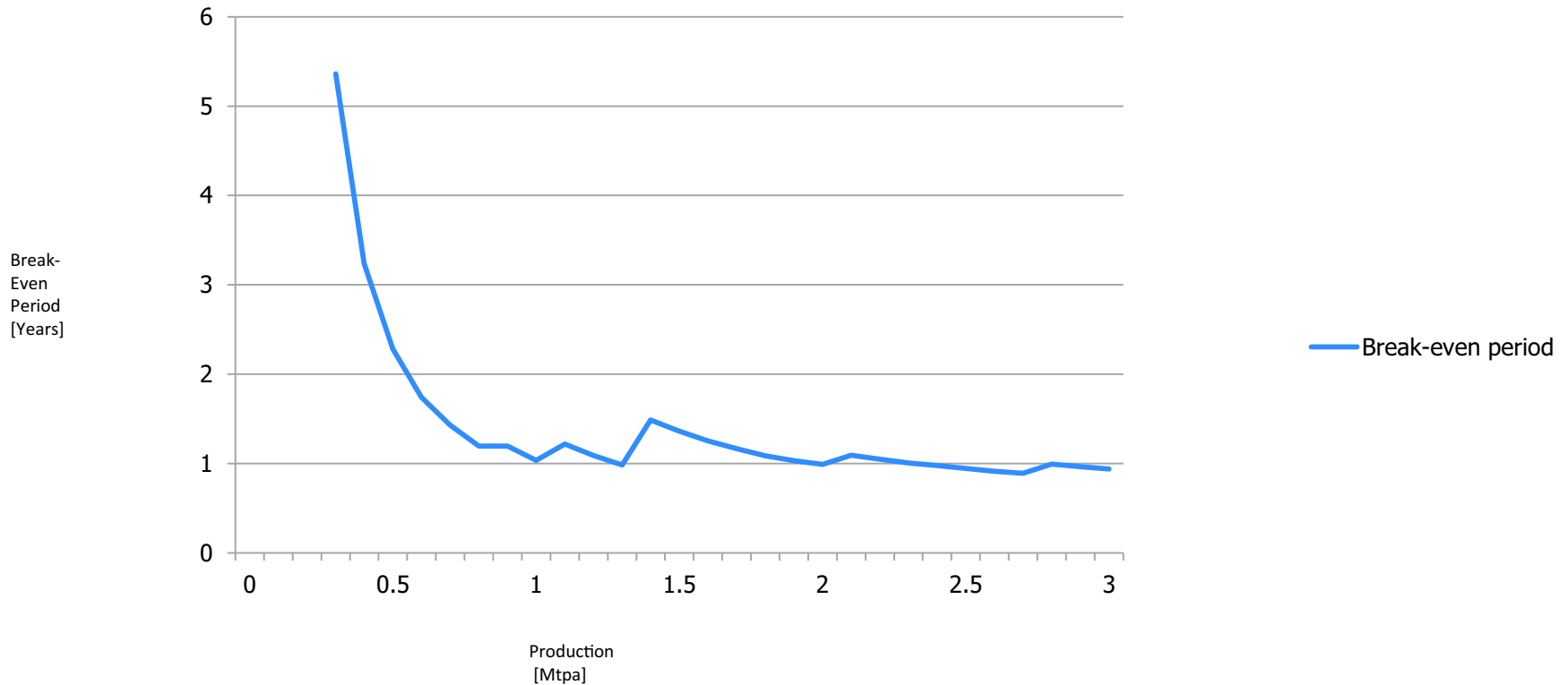


Costs

- Seafloor Mining Tool
 - Capex: \$84,1 Million
 - Opex: \$15 Million per annum
- Vertical Transport System
 - Capex: \$101,1 Million
 - Opex: \$8,46 Million per annum
- Mining Support Vessel
 - Capex: \$197,5 Million
 - Opex: \$52,85 Million per annum
- 3 Barges
 - Capex: \$10,8 Million
 - Opex: \$13,8 Million per annum

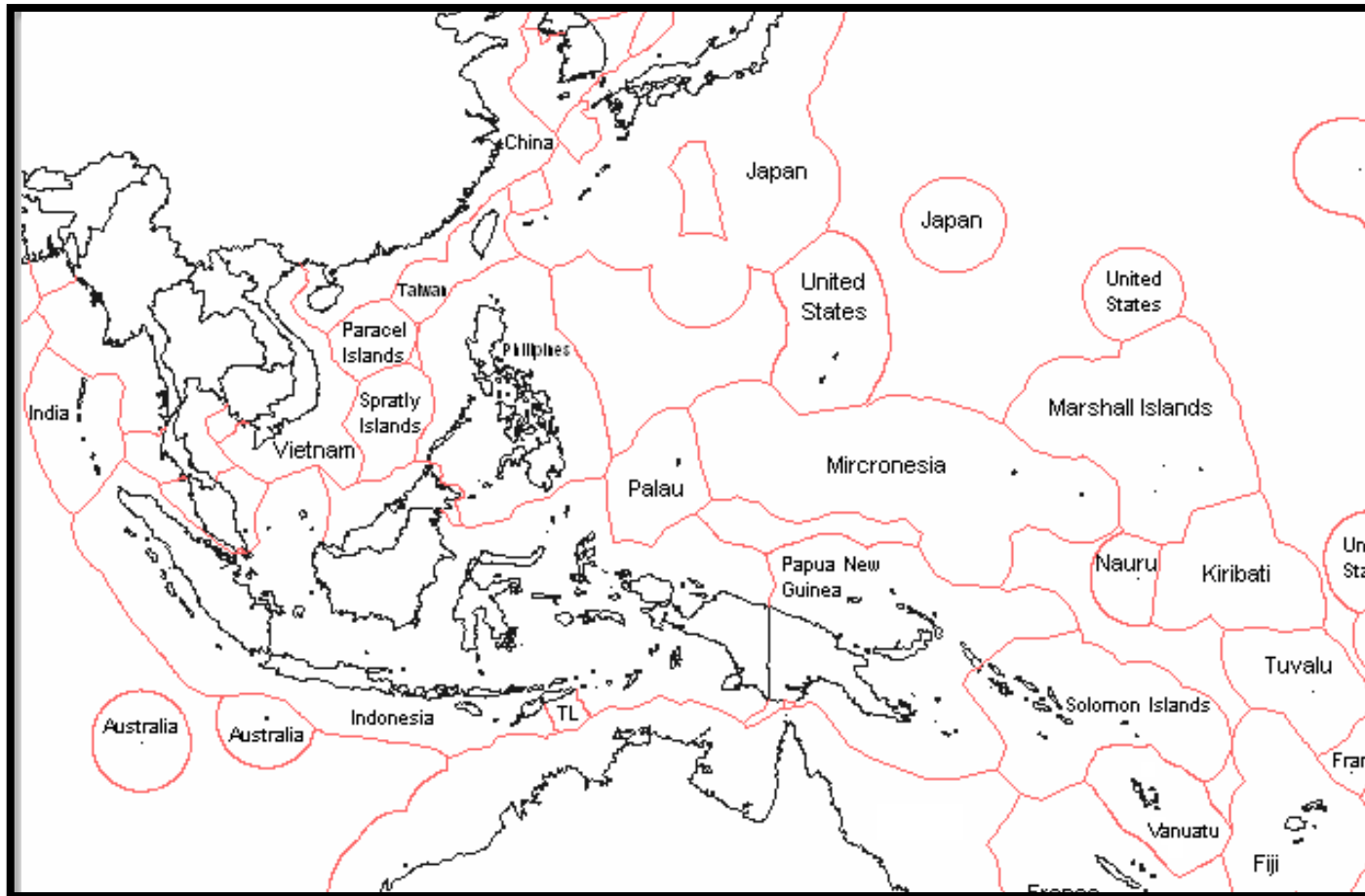
Economical Evaluation

Break-even period vs production



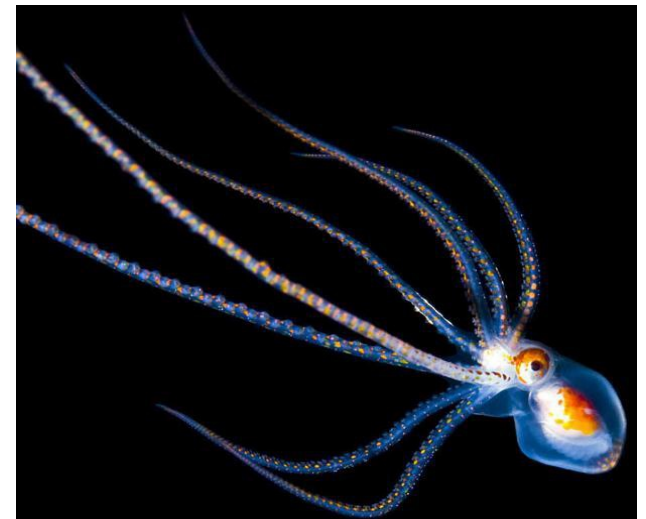
Legal Evaluation

Exclusive Economic Zones



Environmental Evaluation

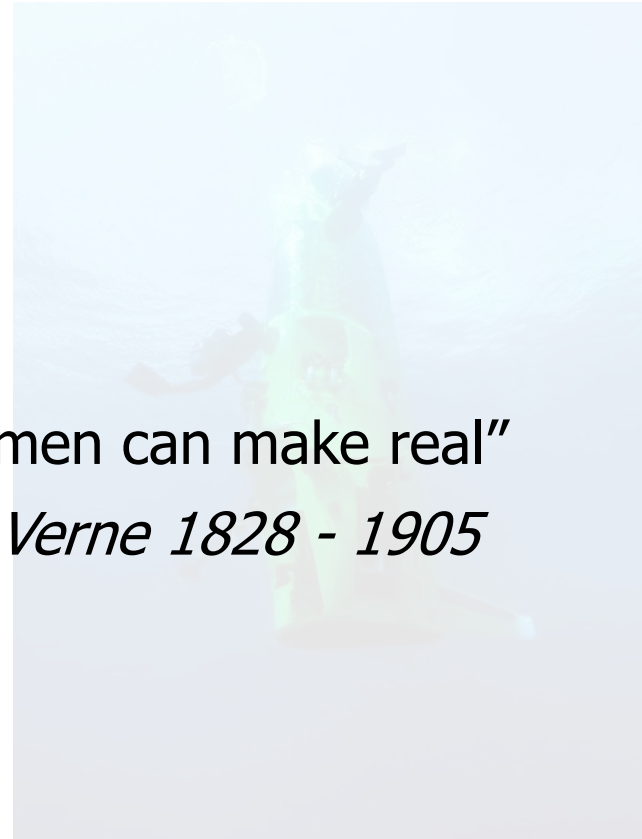
- Mine only inactive vents
- Suction and filtering of plumes
- Prevention of chemical pollution



"Anything one man can imagine,
other men can make real"
Jules Verne 1828 - 1905



Trieste – 1960



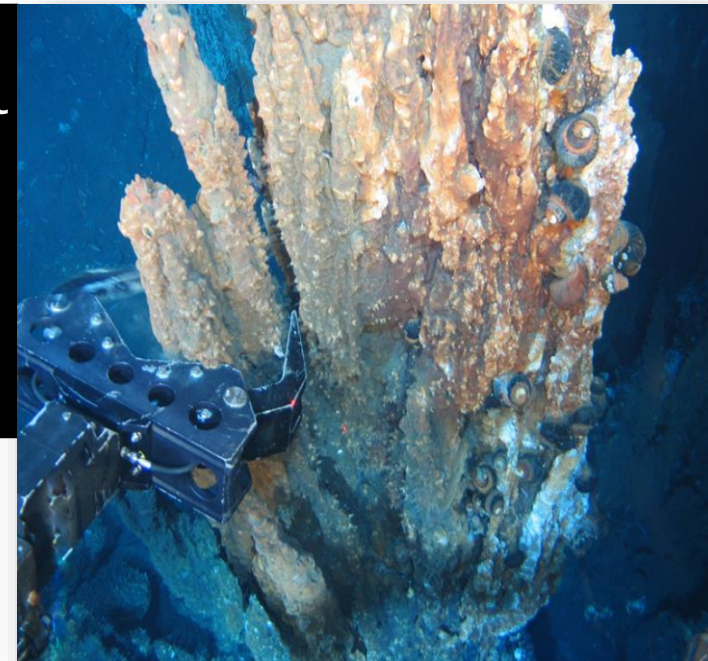
James Cameron - 2012

Conquering the Deep Sea

'Exploring the Dark'

Deep Sea Minor

14-03-2013



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