Deep-sea mining of mineral resources – chances and challenges of a new field with economic potential

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Deep sea mineral resources

- **Mn nodules** (Ni, Cu, Co)
  - 4000 - 6000 m

- **Co-rich crusts** (Co, Ni, Pt..)
  - 1000 - 2500 m

- **polymetal. sulfides** (Cu, Zn, Pb, Au)
  - 1000 - 3000 m

Schwerin, 11.-12.4.2013
Distribution of deposits

- Mn nodules: deep ocean basins
- Crusts: seamounts (W-Pacific)
- Sulfides: mid-ocean ridges
Arguments for deep sea exploration

- New additional deposits
  - enlargement of resources

- „High Sea“ (long-term contracts with ISA)
  - contribution to stability of supplies

- Technology
  - prospects for high-tech economies
1994: UNCLOS in effect

- Foundation of ISA
- ISA managing seabed resources
- Regulations for prospecting and for mining

Kingston, Jamaica

Schwerin, 11.-12.4.2013
Mn nodules license areas

Mn nodules only:
6 claims (2002)
13 claims (2012)
Trends in marine mineral exploration: Claims, explorations, etc.
Duration: 15 years (exploration)
work program including test of equipment/mining

Sustainable
limit impact on environment

Area: 75,000 km² (Mn nodules)
10,000 km² (sulfides)
Concept of 1984

self propelled nodule collector
Sea floor topography of mining areas:

Slope inclination and escarpments greatly reduce area suitable for mining

an estimated 30% remain
Environmental questions

Important aspects:

- Suspension cloud
- Huge size of affected area
- Extraction of hard substrate

Effect on biodiversity

Based on the UNCLOS, any decision on mining requires a sustainable approach.
Concept for mining technology

- **mining platform**: lifting gear, buffer, …
- **riser pipe**: suspension design, air lift, incl. energy supply and communication string
- **buffer**: for continuous lifting process, clogging prevention
- **collector**: self propelled, extensive sensor technique at collector drum, encapsulated design.
- **collector drum**: floating, variable steel fingers cutting through sediment
Example: sulfide claim

Important aspects:
- Explore > 100 blocks
- Deposits are small and in part subbottom
- Rough terrain in rocky surrounding
Sulfide exploration needs drilling

• **Challenge:** deposits can only be evaluated, if drilling indicates presence of subbottom resources.

• **Problem:**
  too deep to use existing devices

Drilling device
From ROVDRILL
(see SEAFLOOR Geoservices)
Mining Technology Massive Sulfides

Seafloor production system for marine polymetallic sulfides

see Nautilus Minerals

Cutting device see Nautilus Minerals

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Problem:

- Concept only - no existing devices
- Begin of mining at SOLWARA postponed
- Not designed to be used for deposits at high seas (=> 3-4 km water depth)
Existing demand

Exploration:
- high-resolution mapping, hard-rock drilling (deep tow, AUV, ROV)
- long lasting deep-sea energy supply, communications
- monitoring, long-term stations

Mining:
- construction of (proven) mining technology;
- mining vessel, transport barges;
- Metallurgical processing to be designed;
Summary

- Mineral deposits are present
- Global trend towards marine claims

**Challenges**: proven technology for mining, sustainability (limiting impact), (metallurgical process)

**Chances (technology)**:
- **Exploration**: enduring exploration tools, sensor techniques, AUVs for large depth, deep marine energy supply…
- **Mining**: enduring and sustainable mining equipment (collector, riser, mining vessel; environmental monitoring equipment, )

- Future market is quickly evolving, recognize options
Thank you for your attention

Sea floor with dense nodule coverage