MiningImpact

Environmental Impacts & Risks of Deep-Sea Mining

Phase 1
Jan 2015 – Dec 2017 (25 partners / 11 countries)
~14.5 Mio€ (funding: ~11.2 Mio€, incl. ship time)

Phase 2
Aug 2018 – Feb 2022 (30 partners / 9 countries + ISA)
~17 Mio€ (funding: ~11 Mio€, incl. ship time)

Coordinator: Matthias Haeckel, GEOMAR
Belgium: UGent, RBINS
France: IFREMER
Germany: GEOMAR, MPI, SGN, JUB, UBremen, AWI, BGR, UBielefeld, CAUKiel
Italy: UNIVPM
Norway: DNVGL, NIVA, UNEP GRIDA, UResearch, NTNU, SNF, IRIS, UiB
Poland: U Lodz, USzczecin
Portugal: UAveiro, IMAR, CIIMAR, UAlgarve, IPMA
Romania: Geoecomar
Sweden: UGothenburg
The Netherlands: NIOZ, UUtrecht, TUDelft
United Kingdom: USOU, NHM, NOCS, HWU
The International Seabed Authority
Introduction

Impacts of polymetallic nodule mining

- Removal of nodules + 10 cm of seafloor
- Generation of sediment plume that will resettle & blanket the seafloor
- Discharge of sediment waste from surface platform / riser pipe

- Loss of habitat
- Loss of species & genetic diversity
- Loss of ecosystem structure & functions
- Change of surface sediment characteristics & processes

Oebius et al. (2001) DSR II 48
Assessing long-term impacts of nodule mining

- Status of disturbed ecosystems in the DISCOL Area (SO242)
- Implications for future nodule mining in the CCZ (SO239 + JC120)
Clarion-Clipperton Fracture Zone (CCZ)

Revisiting old disturbance tracks and comparing seamounts & nodule fields

Belgian, dredge, 1 year

French, OMCO dredge track, 37 years

Lutz et al. 2007; Vanreusel et al. 2016
DISCOL experiment (Peru Basin)

Seafloor with nodules was ploughed in 1989

Investigated after 0, 0.5, 3, 7 and 26 years

Gausepohl et al. (unpublished)
Introduction

Seafloor habitat mapping

In situ process studies

Lab work
Numerical models
Databases

- eDNA/proteome fingerprinting
- plume, foodweb, biogeochemistry
- photo/video annotation, databases (PANGAEA), species collections

Spatial coverage per hour

Object size (resolution)
Disturbance effects on fauna

Megafauna in the CCZ (ROV video transects)

Sessile fauna
- Crinoidea
- Ceriantharia
- Corallimorpharia
- Antipatharia
- Alcyonacea
- Actiniaria
- Hydrozoa
- Porifera

Mobile fauna
- Holothuroidea
- Ophiuroidea
- Echinoidea
- Asteroidea

Vanreusel et al. (2016) Scientific Reports
Disturbance effects on fauna

Megafauna in the CCZ (ROV video transects)

• No recovery of sessile and mobile megafauna after several decades

Vanreusel et al. (2016) Scientific Reports
Disturbance effects on fauna

Nodule-attached sessile organisms typically associated with mobile fauna

Sketch: Autun Purser, AWI
Disturbance effects on fauna

- Loss of seafloor integrity by nodule and sediment removal generally reduces population densities and ecosystem functions, such as biogeochemical remineralization processes and the productivity of the benthic community.

- Disturbance impacts on nodule ecosystems last for many decades and affect numerous ecosystem compartments and functions.

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**Megafauna density decrease & community shift**

![Graph showing changes in megafauna density and community shift](image)

**Biogeochemical activity**

- Increasing loss of seafloor integrity
- Organic matter degradation
- Respiration
- Microbial secondary production

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Marcon & Purser (unpublished)

Vonnahme et al. (unpublished)
Sediment plume dispersal

Understand fate of particles and effective footprint in space and time
⇒ requires multiple-year time-series of bottom currents
⇒ characterisation of particle size distributions, aggregation, settling velocities
⇒ develop appropriate numerical models

EBS track: sediment blanketing of nodules visible up to 70 m downstream of bottom current (~4 cm/s) depending on seafloor topography
1. Deep-sea ecosystems associated with polymetallic resources support a highly diverse fauna

2. Deep-sea faunal communities show a high variability on small and large spatial scales, but their connectivity over relevant scales for reference zones and for conservation remains unknown

3. Temporal variations of faunal abundances remain unknown due to the lack of long-term ecological time series

4. Loss of seafloor integrity by removal of nodules and surface seafloor reduces population densities and ecosystem functions (e.g. nutrient remineralization, microbial growth, bioturbation activity)

5. Disturbance impacts last for at least many decades (e.g. biogeochemical processes will take >50 years to recover)

6. Sediment plumes will likely blanket the seafloor up to several tens of kilometers outside the mined area

→ Minimizing the large-scale impacts will require careful adaptive spatial planning of mining operations and development of low-impact equipment

→ Environmental management plans need to address current uncertainties of the sediment plume dispersal and spatial variability of the abyssal ecosystem that exists also on local scale

Boetius & Haeckel (2018) Science 359
Outreach activities

- European Maritime Day (May 2016)
- Panel discussion UN World Ocean Day (June 2016)
- Side event at the ISA (July 2016)
- Discussion panel at EU Parliament (Nov 2016)
- BMBF Year of the Oceans 2016/17
- Video installations of artist Armin Linke 2017/18
- Stakeholder Event at the National History Museum London (Oct 2017)

- TV documentaries: Arte, Leschs Kosmos, ZDF KiKa
- Interviews for radio stations, newspapers, journals
- Presentations for general public (e.g. Kiel Week)