Appropriate Environmental Impact Assessment Technologies for Seabed Mining
Affiliation
Research and Development (R&G) Center of Submarine Resources, Japan Agency for Marine-Earth Science and Technology (JAMSTEC).

Academic background
Tokyo University of Fisheries (bachelor degree)
Graduate school of fisheries science, Tokyo University of Fisheries (master degree).
Doctor of Science from Kyoto University.

Career
Ocean Policy Research Foundation (Research Fellow)
The University of Tokyo (Associate Professor)
Incumbent.

Topics of Research
Environmental assessment study of ocean mineral resource development
Interdisciplinary Ocean education / Ecology of benthic organisms in the deepsea.
Topics

Conceptual Requirement for Seabed Mining

Technical Requirement for Seabed Mining
Conceptual Requirement for Seabed Mining
Attention towards ocean mineral resources is growing in the world

The number of applications for exploration area in each year to the ISA
Environmental Impact Assessment (EIA) is also required

- Series of workshops for EIA of deep-sea mining are continued by the ISA-

Workshop on Taxonomic Methods and Standardization of Meiofauna in the Clarion-Clipperton Zone (Dec 2015)

Workshop on Taxonomic Methods and Standardization of Macrofauna in the Clarion-Clipperton Fracture Zone [November 2014]

Workshop to Standardise Megafaunal Taxonomy for Exploration Contract Areas in the Clarion-Clipperton Fracture Zone [Jun 2013]
Rigorous Environmental Impact Assessments (EIA) is also Demanded.

however

EIA study ≠ Pure Science

trade off
Who own the seabed resources?

Deep-sea mineral resources in the \cdots\cdots\cdots\cdots

Areas Beyond National Jurisdictions (ABNJ)

Areas Within National Jurisdictions

The Area and its resources (are)

the common heritage of mankind

who is living in the world

who is living in the coastal states

In any case, development opportunities should be given in addition to some other pioneer investors.
Technical Requirement for Seabed Mining
There are a lot of Technical Requirements

- Analysis for biological samples
- Observe for seafloor conditions

A method that everyone can use

Deep sea research

Economic rationality

Accuracy / precision

1. Analysis for biological samples
2. Observe for seafloor conditions
Imaging Flow Cytometer
an instrument for Meiofauna analysis

- Automatic sorting system
- Automatic photo taking system
Problems of meiofauna analysis 1

- need delicate handling -

smaller animals

fauna in aquatic sediment

Meiofauna Animals of the benthic community that are intermediate in size between macrofauna and microfauna. Operationally defined as >32 μm and <250 μm. (ISBA/19/LTC/8)

need delicate handling

after Pennak (1940)

after Platt (1981)
Problems of meiofauna analysis 2

- need complicated processing -

Preserved by appropriate solution (e.g. alcohol)

Sieve and rinse

Observed by microscope
  - identification
  - counting

Data arrangement
Database

Fixed by fixing solution (e.g. formalin)

Staining (e.g. rosebengal)

Subsampling (by small tube core)

Sampling (by multiple corer: MC)

⇒ need complicated processing
34. Different kinds of sampling equipment can be used depending upon the seabed characteristics and the size of the fauna to be collected. Methods for collecting baseline biological data must therefore be adapted to each specific set of conditions. The use of multiple corers in soft sediments allows the distribution of different sampling tubes from the same station among the specialists that used different techniques for fauna identification and counting. It should be stressed, however, that the diameter of the tubes must be adjusted to avoid excessive disturbance of the sediment or obstruction by large particles such as nodules and rock fragments and that biological samples must be large enough to generate good sample sizes in terms of abundance and biomass for robust statistical analyses.

Sampling and Preservation
i. The workshop recommends that contractors undertake biologically focused sampling cruises and that mixed discipline cruises allocate sufficient ship berth space for biological teams and sufficient wire time to be able to extract enough samples for biology by defining an area of research - both the scientific aims and spatial extent; take samples randomly in the research area as a preliminary survey; and, analyze the samples and assess the species cumulative curve. This would make the estimation of the number of samples required to provide adequate assessment of the number of species possible. Repeated sampling to overcome any shortfall would also need to be done.
In case of meiofauna analysis
Need working efficiency

Need complicated processing
Need large number of samples
Need delicate handling

Need working efficiency

Automatic sorting
Automatic photo-taking

Imaging Flow Cytometry (SIP protocol series NO3)

See ⇒ Ocean Data Practices
http://www.oceandatapactices.net/handle/11329/321
Edokko Mark I
an instrument for long-term seafloor observation system

- Practical Use
- General purpose
Problems of long-term seafloor observation system 1

- need observation throughout a year -

Total mass flux fluctuates annually (after Fukushima et al)

Abundance of Benthic organisms fluctuates annually (after Gooday and Turley)

Deep-sea environment is not constant throughout a year
III. Environmental baseline studies.

13. It is important to obtain sufficient information from the exploration area to document the natural conditions that exist prior to test mining, to gain insight into natural processes such as dispersion and settling of particles and benthic faunal succession, and to gather other data that may make it possible to acquire the capability necessary to make accurate environmental impact predictions. The impact of naturally occurring periodic processes on the marine environment may be significant but is not well quantified. It is therefore important to acquire as long a history as possible of the natural responses of sea-surface, mid-water and sebed communities to natural environmental variability.

Environmental baseline should be obtained by multiple observations.

III. Environmental baseline studies.

Baseline data requirement
15. (e) (vi)
Establish at least one station within each habitat type or region, as appropriate, to evaluate temporal variations in water column and sebed communities.

Problems of long-term seafloor observation system 2
- the recommendation is seeking to search temporal sebed variability -
Problems of long-term seafloor observation system 3
- the recommendation is seeking to search **continuously** at least one year -

Annex I
Explanatory commentary
36. The data to be collected and the corresponding methodology for the various classes/sizes of seabed fauna should be as follows:

(f) Demersal scavenger. A time-lapse baited camera should be installed at the study area for at least one year to examine the physical dynamics of surface sediment and to document the activity level of surface megafauna and the frequency of resuspension events. Baited traps may be used to characterize the community species composition. Amphipod necrophage communities should be determined using short-term (24-48 hours) baited traps.

Survey cruises more than once per year are not realistic
Deep-sea environment is not constant throughout a year to acquire seabed communities to natural environmental variability. to evaluate temporal variations and seabed communities.

Need observation throughout a year (From economical point of view) Multiple survey per year are difficult

Need technical development The Area and its resources are the common heritage of mankind.

technical developments should be done not only for pioneer investors, but also new entrants (light-weight, compact body, ready-made parts, easy to use)

See ⇒ Ocean Data Practices
http://www.oceandatapractices.net/handle/11329/321
Thank you for your kind attention

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