Japan's Work of Cobalt Rich Crusts Exploration And Technology Development

“Challenge for deep sea mineral resources development”

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Japan Oil, Gas and Metals National Corporation
Japan’s work of Cobalt Crust Exploration And Technology Development

- Who we are
- Deep sea mineral resources
- Government’s ocean development policy
- JOGMEC’s activities on deep sea mineral resources
- Contract with ISA for cobalt rich ferromanganese crusts
- Conclusion
Who we are

Japan Oil, Gas and Metals National Corporation (JOGMEC)

- An incorporated administrative agency established by the Japanese government in 2004
- Focusing to maintain stable supply of mineral and energy resources under the JOGMEC Law

Ministry of Economy, Trade and Industry (METI)

Since 1963
Metal Mining Agency of Japan (MMAJ)

Since 1967
Japan National Oil Corporation (JNOC)

February 2004

Japan Oil, Gas and Metals National Corporation (JOGMEC)

Oil, Natural Gas
Metals
Stockpile
Environment
Coal
Geothermal energy
Deep sea mineral resources

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Three categories of deep sea mineral resources

- **Polymetallic Sulphides**
  - Copper, Lead, Zinc, Gold, Silver, Rare Metals

- **Polymetallic Nodules**
  - Manganese, Copper, Nickel, Cobalt

- **Cobalt-rich Ferromanganese Crusts**
  - Manganese, Cobalt, Nickel, Copper, Platinum

**Depth**
- **Subduction**
  - 800–3,000m
- **Spreading axis**
  - 4,000–6,000m
- **Back arc**
  - 800–2,400m
- **Trench**
  - Depth 800–3,000m
- **Sea mount**
  - Depth 800–2,400m
What are deep-sea mineral resources

Polymetallic sulphides (PMS)

Cobalt-rich ferromanganese crusts

Polymetallic Nodules

- Polymetallic nodules
- Co-rich ferromanganese crusts
- Polymetallic sulphides
Usage of metals contained in seabed minerals

Ferromanganese Nodules
- Nickel
- Cobalt
- Platinum
- Rare Earth
- Copper
- Lead
- Zinc
- Gold
- Silver

Polymetallic Sulfides
- Stainless Steel (Ni)
- Gas Catalys (Pt)
- Secondary battery (Ni, Co)
- Motor (REEs)
- Battery (Pb)
- Steel plate (Zn)
- Jewelry (Au, Pt)

Cobalt-rich Ferromanganese Crusts
- Nickel
- Cobalt
- Platinum
- Rare Earth
- Copper
- Lead
- Zinc
- Gold
- Silver

Usage of metals contained in seabed minerals
Government’s ocean development policy and JOGMEC’s activities

Japan Oil, Gas and Metals National Corporation
Deep sea mineral resources research by MMAJ/JOGMEC

**Basic research**

1975~1996 Polymetallic nodules

1985~ Polymetallic sulphides

1987~ Cobalt-rich ferromanganese crusts

1985~2005 Cooperation with SOPAC* (nodules, sulphides, crusts)

**MMAJ**

2003

**JOGMEC**

2004~

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**new R/V HAKUREI**

Launched in 2012

**R/V Hakurei-maru**

1975-2000

**R/V Hakurei-maru No.2**

1980-2011

*SOPAC: Committee for Coordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC)

**R/V Hakurei-maru No.2**

**Overall length**: 118.3m

**Breadth**: 19.0m

**Gross tonnage**: 6,200t

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Framework of ocean management of Japanese government

Basic Act on Ocean Policy (Act No. 33 of April 27, 2007)

- Basic Plan on Ocean Policy (2008)
- Plan for ocean energy and mineral resources development (2009)

Modification

- Basic Plan on Ocean Policy (2013)
- Plan for ocean energy and mineral resources development (2013)

2008～

Polymetallic Sulphides, Exploration and R&D
Resource evaluation, EIA, mining, processing & metallurgy

2014～

Crusts exploration, Exploration and R&D
Resource evaluation, EIA, mining, processing & metallurgy

JOGMEC

Methane hydrate
Oil, Natural gas
Sulphides
Nodules, Crusts
Rare earth

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JOGMEC’s Activities on deep sea mineral resources

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HAKUREI’s survey tools

2 types of drilling system
- Derrick type
- Sea bed type

Derrick type (On board drilling system)

Sea bed type (Benthic multi core system)

Deep tow

CTD

Multiple corer

Acoustic (SBP, MBES)

ROV

Grab

SSS
HAKUREI, featuring two styles of marine drilling

Onboard drilling machine system

Large scale stern crane ‘A-flame’

Azimuth thruster (360 degree propulsion)

Bowthrusters (3 sets)

Solar panels

Moon pool

Japan Oil, Gas and Metals National Corporation
Deep sea drilling equipment of HAKUREI

Benthic multi-coring system (BML)

- Maximum Drill Length: 50m
- Maximum Water Depth: 3000m

On-board drilling machine system

- Maximum Drill Length: 400m
- Maximum Water Depth: 2000m
Polymetallic sulphides (PMS) fields widely distribute in Okinawa trough and Izu-Bonin back-arc basin within Japan’s EEZ.
Significant results of recent 5 years

**Discovery of new hidden sulphide bodies at around 30m or deeper under sea-floor in IZENA, OKINAWA trough during 2013 drilling cruise.**

(JOGMEC, 2013)
R&D of mining technology for PMS

Concept design of mining system for PMS

(METI et al., 2013)
Sea-trial of mini-scale mining tools

1st trial

2nd trial
Aug. - Sep. 2013

R/V HAKUREI

ROV

Test miner

On-land test, Jan. - 2014
Mineral processing test for PMS

Samples of Bayonnaise

Samples of Izena

Floatation laboratory test
Contract with ISA on cobalt-rich ferromanganese crusts

Japan Oil, Gas and Metals National Corporation
ISA and JOGMEC sign exploration contract on January 27, 2014
Location of Japan’s exploration area

- Exploration area is located approximately 2500km Southeast of Tokyo in the Western Pacific.
- The area comprises 150 blocks, each with an area of 20 square km, and is located over 6 seamounts.

![Map showing the location of Japan's exploration area with 6 seamounts and EEZ (Japan)]
Research activities over crust deposit

Summit Depth 1000~2000m

Bottom Depth 6000m

Cobalt rich ferro-manganese crusts

3,000m - 4,000m

Drilling at the sea bottom

ROV observation of crusts

Research vessel “HAKUREI”

Remotely operated vehicle (ROV)

Benthic multi-coring system (BMS)
<table>
<thead>
<tr>
<th>Stage year</th>
<th>Exploration work</th>
<th>Environmental survey</th>
<th>R&amp;D</th>
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</thead>
<tbody>
<tr>
<td><strong>Stage 1</strong></td>
<td>Preparatory work</td>
<td></td>
<td></td>
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<tr>
<td>(year 1-5)</td>
<td><strong>Resources evaluation</strong></td>
<td></td>
<td><strong>Pre- R/D in</strong> Mining, ore beneficiation, Metallurgical technologies</td>
</tr>
<tr>
<td>(2014-2018)</td>
<td>Core sampling with geological and geographical surveys <em>(Collection of data)</em></td>
<td>Environment baseline study</td>
<td></td>
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<tr>
<td><strong>Training</strong></td>
<td>Four training opportunities <em>(on-board and on-land)</em> between 2014 and 2018</td>
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<td></td>
<td>12 trainees will be accepted</td>
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<tr>
<td><strong>Stage 2</strong></td>
<td>Detailed resource evaluation of the proposed blocks. <em>(Choose promising blocks 1/3)</em></td>
<td>Continuing environmental study.</td>
<td><strong>R/D in</strong> mining, ore beneficiation, metallurgical technologies</td>
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<td>(year 6-10)</td>
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<td><strong>Stage 3</strong></td>
<td>Further resource evaluation of promising blocks to be exploited from ten years evaluation. <em>(Choose developing blocks)</em></td>
<td><strong>EIA</strong></td>
<td><strong>Verification of technologies</strong></td>
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<td>(year 11-15)</td>
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Conclusion

◆ JOGMEC has been conducting research on deep sea mineral resources since 1970’ and have accumulated experiences in this area.

◆ JOGMEC executes extensive surveys for PMS within Japan’s EEZ since 2008. JOGMEC carries out, not only resource assessment, but also technical development for mining and processing in consideration of environment impact mitigation.

◆ JOGMEC’s 15 year exploration contract with ISA for crusts just begins in 2014. For the conduct of the contract, JOGMEC will apply its experience and sophisticated technology in consideration of environment impact mitigation and technical transfer.

◆ JOGMEC expets to maximize synergies between PMS programme and Crusts programme.