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GROUP PROJECT BRIEF

Potential Deep-Sea Mining of Seafloor Massive Sulfides: A Case Study in Papua New Guinea

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Introduction

Mineral resources are becoming increasingly difficult to extract on land, and recent deep-sea research has identified rich ore deposits that may be economically extractable through the development of a deep-sea mining industry within the next decade. Deep-sea mining (DSM) exploration has already begun. During January and February 2006, Nautilus Minerals and Placer Dome carried out their first drilling cruise of seafloor massive sulfide (SMS) deposits in the Bismarck Sea, Papua New Guinea (PNG). DSM represents a new trend in ocean exploration which has significant unanswered questions about the potential environmental impacts and the sustainable use of ocean resources.

Project Objectives and Approach

This project investigates the Nautilus Minerals and Placer Dome operation in PNG as a case study to preemptively address the potential impacts of this new industry.

The specific project objectives include:

1. Create a public document that will identify the most pressing issues for consideration by DSM companies and stakeholder groups before DSM occurs.
2. Develop a set of recommendations based upon the findings of the research that may influence the nascent industry.
3. Create a 7-10 minute documentary film for general distribution by conducting interviews with scientists, industry members, legal and policy experts, and group project members that explore deep-sea mining issues.

To achieve these goals a literature review was carried out, focusing on five topic areas: 1) identifying stakeholders and their concerns, 2) the active and in-active hydrothermal vent environment, 3) DSM extraction technology, 4) potential impacts from the use of this technology, and 5) legal and policy issues of mining in territorial waters. In addition, the project established a working relation with the mining companies involved and contacted specific researchers in the field.

Background

The primary reasons for the mining industry's current interest of the deep-sea are three-fold: 1) SMS deposits are located at relatively shallow depths and accessible by current technology 2) DSM may be cheaper than terrestrial mining 3) the global demand for minerals is increasing, specifically the future economies of India and China may demand large amounts of copper, thus making DSM even more economically viable. If mining operations do proceed, then PNG may be the first country in the world to test and develop the DSM processes.

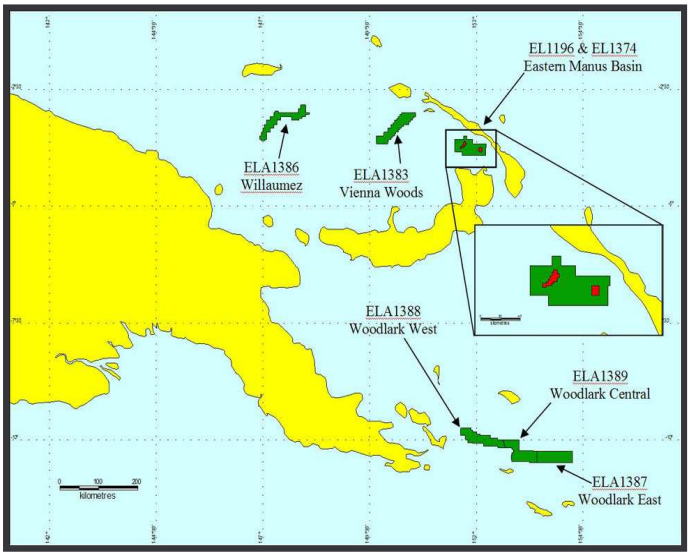

Figure 1. Map of Nautilus Exploration Leases off in the Manus Basin of Papua New Guinea.

Environment

The deep-sea environment in the Manus Basin presents several particular challenges to DSM. The deposits are located in a back-arc basin where the terrain can be rugged and in an environment of extreme conditions including high pressure (under ~2000 meters of water) and temperature ranges from 4 to 400°C (near active vents). Lease tenements are located in areas which contain active hydrothermal venting and old inactive areas.

Potential mining operations will take place at inactive SMS deposits. Communities at inactive areas are not sufficiently understood currently, however preliminary studies are underway. Active vent sites are adjacent to inactive vent areas and may be impacted by mining activity. Active areas host an abundance of organisms; the mining industry will have to determine if their activities will impact communities at both active and inactive areas.

Figure 2. Fauna associated with active hydrothermal venting area (formation of a Seafloor Massive Sulfide deposit) in the Manus Basin of Papua New Guinea.

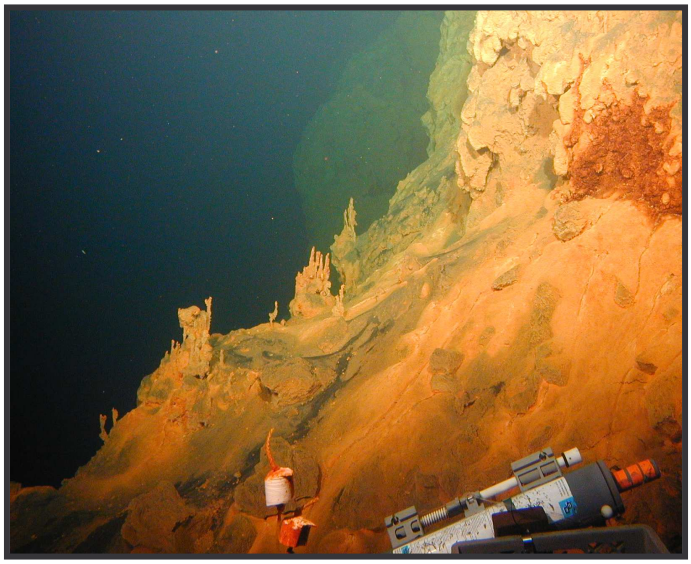

Figure 3. Inactive Seafloor Massive Sulfide Deposit in the Manus Basin of Papua New Guinea.

Technology

The design and application of technology will largely determine the impacts of DSM on the environment. Much of the current DSM technology has been adapted from the offshore petroleum and communications industries. DSM will occur in a series of phases: 1) exploration, including sampling and drilling; 2) extraction, ore is broken up by a drum cutter mounted on a remotely operated vehicle (ROV), 3) transportation, broken ore is pumped up a riser pipe to the platform, dewatered, and shipped to shore, 4) processing, DSM will use the same processes used for terrestrial mines.

Potential Impacts

The impacts from DSM have mainly been studied by looking at the potential mining of nodule deposits. To better understand and identify the potential impacts, a brief review of nodule DSM research was completed. Information gathered from the nodule research led to the identification of potential impacts from exploration and extraction of SMS deposits. These impacts include direct physical disturbances, sediment disruption creating plumes, acoustic impacts, waste water disposal, and machinery leaks and malfunctions.

Placer Dome may be the first company to conduct a full scale deep-sea mining operation; it is essential that they identify and quantify the impacts of their operations. A rigorous, peer reviewed monitoring methodology will be necessary to conduct a comprehensive and targeted biological environmental impact assessments. We suggest the Before After Control Impact Paired Series (BACIPS) methodology as an appropriate sampling methodology because it is explicitly designed to address uncertainty in the marine environment.

Law and Policy

Finally, the importance of law and policies addressing deep-sea mining should not be marginalized. Establishing regulations allows all deep-sea mining stakeholders to have a better command of their interests, including the effective management of marine mineral extraction, corporate social responsibility, and environmental protection. In this study, we identified and assessed laws and regulations that are applicable to the deep-sea mining case study in PNG including; international legislation, national legislation and environmental regulations in PNG, local and state government legislation in PNG, the Madang Guidelines, and Code for Environmental Management of Marine Mining.

Recommendations

The recommendations for this report cover a wide range of issues with regard to the environment, technology, policy, and stakeholders. We have identified issues which should be considered as DSM progresses. A set of recommendations is provided to address each identified issue.

Issue: There is inherent uncertainty in developing a new industry in an unfamiliar and extreme environment

Precautionary Principle

Companies involved in exploration and extraction in this new developing industry face many uncertainties. Due to the high uncertainty and lack of research we recommend that the PNG government and industry invoke the precautionary principle as an overall approach to deep-sea mining of SMS deposits. An example of this is the establishment of conservation zones to preserve habitat

If trial mining moves ahead, then Placer Dome will be required to identify and mitigate impacts under the PNG Environmental Planning Act. We recommend that Placer Dome establish impact zones and preservation reference zones to conduct a valid environmental impact assessment that addresses uncertainty that will stand up to scientific critique.

Scientific Research and Cooperation

Research will help reduce some of the uncertainty surrounding potential deep-sea mining. We recommend industry collaborate with stakeholders such as NGOs and scientists. Specific areas for collaboration with other stakeholders include research on potential acoustic impacts, dose response reactions to sediment plumes, and the possibility of affecting vent fluid flows.

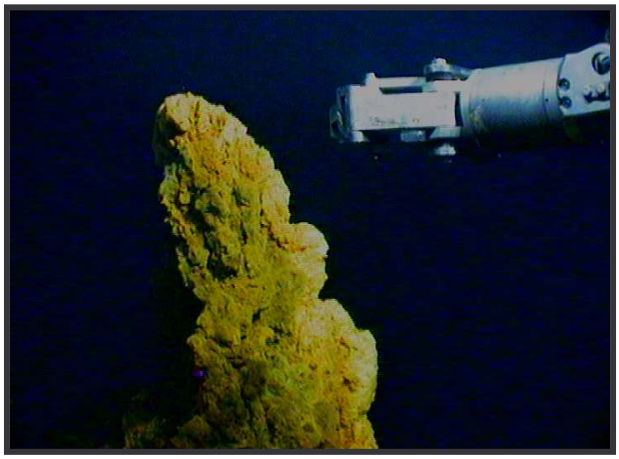

Figure 4. Arm of the Remotely Operated Vehicle taking a sample of an inactive SMS Deposit in the Manus Basin.

Policy Implementation

The draft "Green Paper" Offshore Mining Policy Act has a framework that (1) addresses uncertainty, (2) provides a flexible licensing and leasing regime, (3) requires marine specific baseline data gathering. Currently the act has been put on hold awaiting industry startup. We recommend that PNG finalize and implement this policy.

Issue: Mining will occur in areas of local "common heritage" and ownership in PNG. Other parties, including the public at large, have a right to know how their natural resources are being treated.

Information Disclosure

It is important that company operations with the potential to impact other stakeholders or the public interest at large are reported within a reasonable period prior to implementation to allow for public comment.

We recommend that mining companies proactively disclose information about the project to all stakeholders. Additionally, the mining companies should open an information center at a local site, assign an information officer to the project, as well as hold public hearings when appropriate.

Establish an Advisory Committee of Key Stakeholders

Mining companies need to identify stakeholders and maintain open communication. We recommend that mining companies develop a stakeholder registration system and establish an external advisory committee. Federal, state and local officials should also be asked to join the committee.

Further, as the provincial governments of New Ireland, due to the Organic and Lands Groups laws, indigenous clans have a potential say in the conservation of natural resources within their province. We recommend Placer Dome consult with the authorities of the New Ireland province as they develop and implement an environmental plan.

Experience Transfer

As PNG will be the first country in the world to potentially experience deep-sea mining, we recommend knowledge and experience transfer between PNG and other states that are developing DSM policy. Experience transfer will benefit other states. They will be able to bypass costly and time consuming mistakes, and implement proven policy applications.

Issue: DSM will impact the environment.

Sediment Plumes

We recommend the development of plume reduction and prevention technology, as well as further research concerning the dose-response of organisms.

Acoustics

The potential consequences of sound impacts from DSM warrant further study.

Waste Water Disposal

We recommend disposal at the mining site or lower elevations to prevent contamination of the water column or impacts to vent ecosystems.

Figure 5. A Remotely Operated Vehicle (ROV) used to examine the active and inactive SMS deposits in Papua New Guinea

Issue: Information and knowledge about the deep-sea is limited. It is expected that new seafloor marine science may discover new impacts unforeseen during the development of DSM technology.

Adaptive Technology Development Strategy

We recommend the development of adaptive technology programs and designs to provide engineering flexibility for effective and efficient response to new marine science data.

Life Cycle Assessment (LCA)

We recommend that LCA assessments be used in the development of DSM technology and promotion.

Issue: Policy frameworks for DSM have already been developed.

Guidelines, Codes & Best Practices

We recommend that states use the Madang Guidelines as a framework and the Code for Environmental Management of Marine Mining to create a DSM industry standard within the offshore policy regime.

To help create transparency we recommend the DSM industry actively promote the Code of Environmental Management of Marine Mining as a best practices methodology.

Conclusion

The methodology used in this case study identified, contacted, and opened a dialogue between the group project members and key players from industry, non-government organizations (NGOs), the PNG government, and scientists currently studying hydrothermal vent systems. An extensive literature review complemented by personal communications with experts provided the foundation for a set of recommendations for each chapter topic. It is our hope that the mining industry can use these recommendations to identify and mitigate environmental impacts before they occur.

A documentary film on DSM issues was made for a general audience as an outreach companion piece to the report. Interviews with scientists, industry members, legal and policy experts, and group project members were conducted.

Throughout this project we have found deep-sea mining industry and stakeholders to be interested and open to environmental discussion to identify, minimize, and mitigate impacts. It is our hope that this paper provides solutions and will lead the way for the stewardship of our ocean resources.

Acknowledgements

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