



## **Nautilus Minerals Inc.**

**DEEP-SEA MINING SEAFLOOR MASSIVE SULFIDES PAPUA NEW GUINEA**  
(Including the August 1, 2008 Post Conference Report on Nautilus Minerals Niugini)

**July 26, 2008**

**Prepared for:**

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**Post Conference Report on Nautilus Minerals Niugini**

August 1, 2008

Dr. David E. Martin

On the 24<sup>th</sup> of July, 2008, M·CAM presented the PIFS & PIPSO Fiji Conference on Intellectual Property Rights and Traditional Knowledge the preliminary report on the undersea mining efforts undertaken by Nautilus Minerals. During the conference, topics including the company's corporate and financing history (including a biographical review of its principle managers and investors); status of ownership (or lack thereof) of intellectual property rights for the proposed undersea and surface operations; summary of prospective implications of the International Seabed Authority guidelines, the Convention on Biological Diversity, and other relevant environmental regulatory schemes on proposed operations in Papua New Guinea, Fiji, Tonga, Solomon Islands, and New Zealand and their relevance on environmental concerns posed by Nautilus' plans; and, summary of known risks to traditional knowledge and resource rights of the communities bordering the Bismarck Sea were discussed. The official debut of the formal report was made in a series of meetings beginning on the 26<sup>th</sup> and 27<sup>th</sup> of July in Port Moresby, in the Komgi Village on the 28<sup>th</sup>, and in the Gazelle District Headquarters on the 30<sup>th</sup>. With unanimous endorsement to initiate more careful investigation of the proposed operations of Nautilus and with the further resolution to work to create an independent cataloguing, monitoring and oversight process to insure the safeguarding of national marine and terrestrial resources, all parties concurred that there is, at present, sufficient opacity so as to preclude entering into full-disclosure binding agreements regarding Nautilus access to land and sea resources to commence operations. The leadership of the Komgi Village has unanimously voiced its opposition to authorizing any use of, or access through, lands under their common control at this time pending the adequate addressing of all concerns regarding guaranteed and absolute preservation of all marine and terrestrial ecosystems.

In the meetings in Nadi, Fiji and the Port Moresby and Rabaul regions of Papua New Guinea, it was abundantly clear that local and regional leadership have inadequate information regarding both the Nautilus company and its explicit technical plans. It was further clear that no participant in any of the meetings had been aware of the degree to which the proposed technology deployment was likely subject to significant international intellectual property considerations that were neither owned nor overtly documented to have been licensed to the company. It was further obvious that the awareness of local biological diversity and its documented (and in some cases, expropriated) uses was inadequate to insure any appropriate oversight and management of indigenous resources by the Government of Papua New Guinea. Examples ranging from immunologic uses of local algae and crustaceans, to antiseptic and antibiotic uses of certain coastal minerals, to coastal plants that are implicated in the treatment of cardiovascular disorders, were evidenced in community conversations and have been inadequately addressed by regional or national governing bodies. Given the present flux in the awareness of intellectual property and traditional knowledge schemes in Papua New Guinea and the country's current exposure to

significant and commercially-uninformed pressure from the United States, Australian, and World intellectual property organizations and offices, the notion that there exists a national capacity sufficient to address these issues in a fair manner is beyond any reasonable expectations at this time.

Without exception, the participants were unaware of the degree to which the company has contracted with worldwide corporate, academic, and scientific organizations to assist them in framing the marketing and environmental message. While there was uniform and deep respect for the country manager hired by Nautilus (albeit somewhat apprehensive with the notion that his affiliation with Transparency International might confound regional and national access to independent intelligence on corporate activities), review of minutes of meetings held by the company and interviews with attendees of the same meetings evidenced an apparent suboptimal technical and environmental information transfer to date. It was clearly observed that Nautilus has a considerable opportunity to vastly enhance effected community awareness should it elect to do so.

With respect to the attached report, M-CAM has not encountered any field evidence which would alter the observations and recommendations made therein. In addition to these recommendations, following our meetings in Papua New Guinea, we will commence finalizing the technical intellectual property dossier and work with Pacific Island Nation's public and private sector organizations to develop a database – made available to concerned community and policymaker bodies – to build awareness on technical options and their proprietary owners that could be implicated in the company's operations as publicly disclosed. It is our expectation that this information will assist in managing the current information asymmetry evident in the effected communities. In coordination with PIPSO, PIFS, or other recognized regional bodies, this information may be shared with Nautilus, should it so desire, only in the presence of representatives from Baining, Komgi, Manus, New Ireland, and East New Britain district and provincial authorities, in audio and video recorded sessions overseen by independent observers. M-CAM shall retain all materials in a secure, electronic, auditable format so as to provide all parties with an auditable record of information transfer.

We reaffirm our belief that the social, financial, and technical merits of the Nautilus business proposition would be profoundly and positively improved should all effected community interests be addressed. M-CAM is committed to working with all parties to insure that generations to come enjoy the benefit of the unique biological, cultural and terrestrial diversity of the Bismarck Sea and the greater Pacific region.

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## **EXECUTIVE SUMMARY**

Nautilus Minerals Inc. is currently accelerating efforts to commence mining and removal of the oceanic natural resources from Papua New Guinea (PNG). Nautilus is working to extract copper, zinc, gold, and other metals from massive sulfide deposits in the waters of PNG's exclusive economic zone at depths up to 2000 meters; while other companies are involved in undersea mining, Nautilus is closer to commercial extraction than any other company. The Nautilus Solwara I project in PNG is expected to begin commercial mining operations in 2010. Given the degree to which Papua New Guinea has come to rely on mineral exploitation as a means to grow its GDP (now estimated to contribute over 30% to the sustained GDP growth over the past few years), it is clear that the financial motivation to proceed with this project enjoys considerable international investor and national Government support. However, without proper oversight and internal discipline on the part of the Government of Papua New Guinea, Nautilus and its partners, this undersea mining has the potential to be socially, economically, and environmentally destructive. Through appropriate process management, the use of leading technologies, careful monitoring and constant inspection these risks can be minimized. This report provides an overview of Nautilus, undersea mining in Papua New Guinea, and M·CAM recommendations for impact minimization and long-term value optimization. This report compiles information available in the public domain so attribution and conclusions drawn therefrom are predicated solely on the accuracy thereof.

## NAUTILUS OVERVIEW

Nautilus Minerals Inc. is a Canadian and Australian-based company recently listed on the London and Toronto stock exchanges. Nautilus was formed to extract rare and valuable minerals including gold, silver, copper, zinc, nickel, and cobalt from underwater deposits. Nautilus is currently working toward commercial extraction of these resources at depths up to 2000 meters in areas across Oceania, with investigative mining occurring foremost in Papua New Guinea (PNG). PNG has granted Nautilus exploratory licenses to 154,000 square kilometers of seabed in its exclusive economic zone; Nautilus' total exploratory rights in the South Pacific total 370,000 square kilometers. In addition to PNG, Nautilus has rights to claims or prospects in Tonga, Fiji, Solomon Islands, and New Zealand. Nautilus has formed a Tongan subsidiary to gain preferential access to international waters in the International Seabed Authority (ISA) area of authority. Nautilus has moved quickly toward commercializing undersea deposits and is further along in the process than any other undersea mining interests. The PNG Mineral Resources Authority has expedited the licensing and permit process to increase investment; Nautilus has used this to secure rights to virtually all of PNG's undersea mineral deposits.

Out-going Nautilus CEO, David Heydon, has extensive mining experience. Referring to his experience with zinc mining in the Australian outback, he stated "All you needed to do was get a dog, a 4x4, chop a tree, cut it in four pieces, hammer the stakes into the ground- and you're a millionaire."<sup>1</sup> He later pursued gold mining in Indonesia, asking Indonesian villagers with prominent gold jewelry where it had come from in order to identify gold-rich areas. In the 1990s, Heydon branched out from mining, establishing an off-shore regulation-free internet service. In 2002, after this endeavor had collapsed in the dot-com bust he cofounded Nautilus with partner Julian Malnic. In 1995 Malnic had obtained claims to undersea rights in PNG after allegedly photographing maps in explorer Ray Binns' office. Heydon helped find investors and raise money for the operation, including an investment of \$US 12 million in seed money from mining company Placer Dome (later bought by gold-mining giant Barrick Gold, who operate an onshore mine in Papua New Guinea). Heydon and other investors later bought out Malnic's share of Nautilus.

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<sup>1</sup> [http://www.wired.com/wired/archive/15.03/undersea\\_pr.html](http://www.wired.com/wired/archive/15.03/undersea_pr.html)

Since going public, Nautilus has raised over \$308 million in funding. This funding allows them to actually begin mining mineral-rich areas identified by hundreds of millions of dollars of public seabed research from the past few decades. Nautilus projects that a single undersea mine has possible profits of over \$500 million per year once the mine is operating at full capacity. This return has drawn interest and investment from major mining companies, including Teck Cominco, Anglo American, Epion, and Barrick Gold. As a first mover in undersea mining, Nautilus has provided funding for undersea study and surveying to several research institutions, including Australian National University, the Commonwealth Scientific and Industrial Research Organization (CSIRO) Australia, Duke University, University of Hawaii, Scripps Oceanographic Institute, Woods Hole Oceanographic Institution, University Of California, the Donald Bren School of Environmental Science & Management, and Vulcan/Paul Allen.

Samples from massive sulfide deposits in PNG have shown extremely high concentrations of metals, including 8-12% copper, 18% zinc, 200ppm silver and 11 ppm gold. In total, the deposits in PNG sites are likely to contain several million tons of copper and significant amounts of other metals. In areas of high concentration, values can reach as high as \$3000 per square meter. These high concentrations are formed when mineral-rich water from undersea vents is discharged at extremely high temperatures into the cold ocean-floor water. As the water cools, the metals precipitate out into wide beds along the seafloor. Nautilus plans to use a remote operated underwater mining vehicle to grind up these mineral beds and pump the resulting slurry to the surface in a nearly 2 kilometer long riser pipe. Once the slurry reaches the surface ship, the water is drained from the slurry, the ore is transported to barges, and then the barges transport the ore to land for processing. Nautilus plans to discharge the post-processing tailings back into the water using submarine tailing disposal, a process prohibited in economically developed countries for its environmental damage but still in practice in PNG. Because the mining operation is largely automated, Nautilus currently employs only about a dozen Papua New Guineans; that number is unlikely to grow significantly.

While Nautilus has progressed furthest toward full mining operations, many other organizations are also involved. The private company Neptune started in a different branch of undersea

mining but has recently been moving into the same massive sulfide deposit mining that Nautilus is pursuing. Several governments are also involved in research into this type of mining in international waters, including China, Japan, South Korea, France, Russia, Germany, and India. Despite the ongoing interest, the International Seabed Authority has yet to issue any full mining permits in international waters pending further impact studies.

## **PAPUA NEW GUINEA**

In addition to its importance as a location of major mineral reserves, Papua New Guinea (PNG) is now taking on a global role as the showcase for the first undersea mining endeavors. Mining is a dominant industry in PNG, accounting for as much as 25% of GDP and two thirds of exports<sup>2</sup>. Despite this large presence, few jobs go to the people of PNG and most of the benefits flow to foreign investors. Despite billions of dollars of mineral exports, poverty rates and unemployment both remain high. Mining has also caused social unrest. Exploitative mining practices led to a severe civil war in Bougainville, leading to significant government weakening. While the central Government has launched a number of initiatives to rectify a legacy of public sector accountability deficits, oversight – particularly in exploration and environmental management – has been lax in PNG, with large amounts of corruption and a long history of resource exploitation.

## **NAUTILUS STAKEHOLDERS**

This section provides information on several key players associated with Nautilus. This information can be helpful in illustrating relationships with other entities.

**Stephen Rodgers** is the Nautilus President and CEO Executive Director having served for 16 months as the Chief Development Officer. He will help Nautilus move into mining production, focusing on the Solwara I Project. Rodgers was formerly of Oceania Technip; Technip was

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<sup>2</sup> World Bank. 2007. Project Information Document: Appraisal Stage. PG Mining Sector Institutional Strengthening. Report No. AB2486.



recently awarded a \$116 million contract to provide Nautilus with their lifting and recovery system.

**David Heydon** has moved into the role of Non-Executive Director at Nautilus after five years as CEO. Heydon led the IPO of Nautilus and was largely responsible for raising investments from Teck Cominco Ltd., Anglo American, Barrick Gold, and Epion Holdings.

**Geoffrey Loudon**, chairman of Nautilus Minerals, was the founder and chairman of Niugini Mining. Niugini Mining was instrumental in the discovery of the Lihir Gold Deposit developed by Rio Tinto in 1995 and remains a founding director of Lihir Gold Ltd. He is also chairman of L&M Petroleum.

**Winnifred Kamit**, a PNG lawyer, is on the Nautilus Board of Directors. She is a senior partner in the large Australian law firm Gadens Lawyers and serves as a corporate board member for several other PNG resource extraction firms including Lihir Gold Limited and Britain Palm Oil Company. Winnifred Kamit worked for the government of PNG as Council Member at the Institute of National Affairs and as a Commissioner for the Public Service Commission. She is married to PNG Central Bank Governor Wilson Kamit, appointed by PNG Prime Minister Michael Somar.

Ms. Kamit works with Steve Patrick, the managing partner of Gadens Lawyers PNG. Mr. Patrick acts on behalf of PNG statutory authorities, PNG Harbors Ltd., Air NiuGini Ltd, the PNG Attorney General's office, the Bank of South Pacific, ANZ, Fincorp Ltd., Kina Securities, and the Central Bank of Papua New Guinea (managed by Ms. Kamit's husband).

**Alisher Usmanov** controls Epion Holdings, reportedly the largest investor in Nautilus Minerals. Usmanov had been held in prison in Uzbekistan before continuing his investing in metals, minerals, and steel production through Epion and Metalloinvest. Usmanov is the Director of Gazprom Invest Holding, a subsidiary of Russian state-owned Gazprom. In addition he owns the Russian newspaper Kommerstant and Gallagher Holdings (a conglomerate in mining, steel, pharmaceuticals, and technology).

**Farhad Moshiri** is on the Nautilus Board of Directors. Iranian born Moshiri has partnered with Usmanov in multiple ventures, including Panmure Gordon and Co. via his investment company Northcote. Before partnering with Usmanov, Moshiri worked for Deloitte.

## **IMPACT**

Undersea mining of massive sulfides has potentially devastating environmental impacts. Damage is possible to undersea vent ecosystems from the mining itself, fish and sea life in nearby waters from sediment spills, and surface marine and bird life from barge activity. While Nautilus states that mining will only occur on dormant vents, these are often found in close proximity to live vents and their fragile ecosystems. These ecosystems could easily be damaged by mining disruption and are potential sources for significant amounts of biodiversity that could be used for new medications and technologies. Algae blooms are also possible if care is not taken to use or process nutrient-rich cold water from the sea-floor before release. Any disruptions are likely to long-term in nature since sediment plumes could take between ten and forty years to fully resettle, causing significant damage to nearby marine life populations. These possible disruptions have led to calls by many Papua New Guineans to halt undersea mining.

In addition to the possible damage in the marine environment itself, another source of environmental damage is from the ore processing that is planned to occur on or near the shore with the recovered ore. PNG has a long history of destructive mining processing, including mine tailing dumping in rivers and the ocean and open flows or pits of unmarked hazardous materials. Although the International Seabed Authority has established regulations for undersea mining in international waters, the authority has no jurisdiction within a country's territorial waters or exclusive economic zone. Since Nautilus is operating entirely within PNG's exclusive economic zone, they are not subject to International Seabed Authority regulation and can operate in the more lax regulatory environment of PNG. Given the poor track record of easily monitored terrestrial mining, the difficulty to monitor undersea mining has the possibility to easily go unregulated. Unlike land-based pollution, the effects of undersea disruptions can easily spread beyond PNG waters to affect other nearby countries. The discharge of both standard

flotation techniques for extract processing as well as the ability to deal with post-extraction tailings in a manner consistent with international standards presents both significant challenges as well as unique opportunities for Nautilus should it choose to serve as an exemplar for environmental preservation.

In addition to environmental impact, there is a high probability that lightly regulated undersea mining will cause social and economic disruption for Papua New Guineans. Like many others from the 200 high islands and 2500 low islands and atolls in the Pacific, the people of Papua New Guinea have an important relationship with the sea. The ocean surrounding these islands is more than just water; it represents food, economic livelihood, and highly important cultural symbols that are all crucial to the way of life for the people of PNG. Further, there is deep cultural and spiritual significance to the areas contemplated for barge traffic and on-shore processing.

Although Nautilus has participated in Environmental Impact Studies, the lenient regulatory environment and previous sponsorship of research institutions means there is no guarantee that the methodology or results of these studies will be fully accurate or subject to independent review from bodies with objective disinterest in the enterprise's operations. Further, these studies have not covered the social or economic consequences facing the people of PNG, particularly taking into consideration the cultural values attendant to both the land and sea resources and their role in communal values. In light of these considerations, other assurances need to be instituted before mining commences to help prevent extensive tangible and intangible community degradation from Nautilus' mining efforts. Currently, exploration and mining operations are moving ahead more quickly than regulatory progress. Without substantial effort, it is unlikely that significant regulatory changes will occur before full-scale mining begins. If this occurs, the impact is likely to reach people everywhere, not just in Papua New Guinea.

## **REGULATION**

Establishing codes of practices, conduct, and guidelines prior to any mining activity is crucial to the sustainability of any mining endeavor. While many mining regulatory standards exist, few of

these have been specifically applied to Nautilus. An overview of these standards is given in Appendix I. Given that rights grants to undersea mineral resources are new, it is understandable that some lag exists in setting up regulation. However, this lag will become a problem if it is not solved before 2010 when mining in Solwara is set to start. Good regulation requires technical knowledge, transparency, and a lack of conflicts of interest. Given widespread funding by Nautilus to research groups, independent third parties need to be found and engaged to perform monitoring functions. These independent parties will also need to provide assessments and recommendations for minimizing social impact and providing for an appropriate benefit for the people of PNG during and after mining occurs. While this report focuses primarily on PNG, these guidelines will also need to be extended to cover the other companies and countries pursuing ocean floor exploration and mining. Early guideline adoption is likely to help ease uncertainty and promote better use of these resources.

Because regulation and sustainable use policies tend to be in the long-term interest but against the short-term financial interest of resource extraction companies, the independent regulatory bodies need to have funds and mechanisms available to monitor and enforce the guidelines. When properly structured, this monitoring can help prevent incomplete or inaccurate statements by resource extraction industries that have an interest in appearing environmentally friendly. In sum, ongoing monitoring requires agreed upon, observable, and enforceable regulations.

## **POTENTIAL STRATEGIES**

Given the stage of this process, it is our goal to explore ways in which one could pursue a path that both provides value to Nautilus and its constituents while simultaneously serving the long-term values of the PNG population. Should constructive engagement fall prey to a rush towards full-scale operations without addressing core considerations, we also explore ways in which local population interests, the international community and other parties could align to create an environment in which Nautilus is more explicitly encouraged to establish a model behavior that serves as a benchmark for future undersea resource endeavors.

To engage in the proposed extraction processes that Nautilus seeks to employ based on a review of their public statements and regulatory filings, M·CAM has identified over 1,000 international patents and proprietary interests that impact one or more of their processes that currently have not been acquired by, or assigned to, Nautilus or its subsidiary companies. So far, the public filings made by the company have been relatively silent on the reliance they have on considerable proprietary platforms. Given the increased scrutiny under global trade and economic development agreements, engaging in activities that infringe issued patents could present an interesting conundrum for Nautilus and for the governments of PNG and Australia (one of the countries which have sought to promote IP&R throughout the Pacific). Given Australia's CSIRO involvement with Nautilus, it would seem to be highly advisable for the Australian government to encourage full compliance with international IP&R laws for a company that stands to benefit its economy and interest holders in global public equity markets to such a great degree. We would advocate and have undertaken the process supporting the native populations of PNG efforts to form an Innovation Commons which would license critical seabed management, processing, sensing, monitoring, pumping, separating, and GIS, intellectual properties from third party holders and then sub-license the same to Nautilus to increase their economic benefit from the proposed operation.

Nautilus relies on several partner companies who have highly diversified operations including logistics support for remote operated vehicles (ROV) for exploration and extraction as well as lifting extract materials to the surface. While operation of these within the PNG exclusive economic zone may create limited immediate infringement damages to the IP&R holders in PNG jurisdiction, considerable international interest may be brought to bear on companies supplying this technology under leasing or operating agreements where the nexus of potential monetary damage may be more relevant. While Nautilus has undoubtedly taken into consideration many of these issues, it will be interesting to monitor corporate filings under London and Toronto exchange accounting rules to see how the risk of injunction-based business interruption may impact business operations should these issues not be fully clarified prior to operations. In partnership with Pacific Island national public and private sector leadership, M·CAM has recently disclosed much of the IP&R operational exposure to a variety

of stake-holders from 12 of the 14 Forum member states, some of whom will be future areas of exploration interest by Nautilus.

We would further suggest that, in compliance with the international Convention on Biological Diversity, Nautilus fund local entrepreneurs to assist them in setting up biologic cataloging, surveillance and monitoring businesses (with the appropriate state-of-the-art technology) to ensure preservation of the marine and terrestrial flora and fauna in the impact zone of their activities. Rather than contracting these services to remote MNCs, universities, and NGOs, the employment value and technical development of scientific capacity in the region would serve as an ideal public-private partnership for building community value. We would further recommend that constituents of the Australian National University, the Commonwealth Scientific and Industrial Research Organization (CSIRO) Australia, Duke University, University of Hawaii, Scripps Oceanographic Institute, Woods Hole Oceanographic Institution, University Of California, the Donald Bren School of Environmental Science & Management, and Vulcan/Paul Allen be informed of the activities undertaken by Nautilus and adopt their own policies on training and employing local workforce to enter into constructive monitoring and surveillance. Clearly, aligning august research institutions with educational missions would be fully within their charter and would build international support for ethical resource management strategies. Further, we would encourage these institutions to endorse IP&R oversight policies to insure that their recommendations don't impede the intellectual property positions held by others.

In cooperation with development agencies and UNESCO, Nautilus would be able to provide exemplary leadership if it commissioned, as part of its current US\$30 million permitting and development phase, a comprehensive social impact assessment that would document the traditional values of the people from whom land and water access will be required to do extraction and processing. This could, among other things, include the careful cooperative planning of site location and process controls that are compatible with long-standing social values. In addition, it could foster greater community support for future cooperation if respect and mutual benefit was evidenced at this stage.

Nautilus has chosen to pursue a path as a pioneer in the seabed mineral exploitation market following the oil and natural gas markets in the past. At this moment in time, the company has an unprecedented opportunity to leverage the considerable market premium in commodity prices to invest in creating, in addition to first-in-class mining techniques, unprecedented models for environmental and social engagement. The innovation that makes their business proposition possible has been developed over many years and has been created by a significant number of stakeholders. David Heydon's paradigm of four sticks, a dog, and a 4X4 equals a millionaire now has added to it considerable more dimensions. Those dimensions serve as an invitation to a new paradigm in ecological and ethical innovation and resource management. The Governments of the Pacific Island Nations are at a unique intersection where IP&R and Traditional Knowledge, together with international treaties on biodiversity and trade, all now converge on a question of implementation. Will these espoused values of the new economies for the region be deployed on one of the most entrenched industries in human history – mining?

## **CONCLUSION**

M·CAM recommends that information regarding undersea mining – its enabling technologies and their owners, its environmental repercussions, and its impact on social structures – be more fully disseminated to interested parties including governments, financial regulators, NGOs, and environmental groups.

One of the key groups that should be made aware of the potential environmental effects is the fishing industry, both in PNG and in other Pacific countries and nations, including Japan. These industries can help to monitor and enforce compliance in order to protect their interest in continuing healthy maritime environment. M·CAM would vigorously endorse a program whereby Nautilus form a public-private partnership to support remote sensing and monitoring of all documented biodiversity in both fresh and sea waters that may be impacted by its operations. Further, M·CAM would endorse the local creation of employment, both by foreign environmental consultants to Nautilus, as well as by NGOs, in the form of education and deployment of environmental monitoring and remediation technologies for this project.

M·CAM is working with interested parties to assemble appropriate intellectual property to allow for monitoring activity on-site and at international water boundaries. Additionally, M·CAM has prepared a compendium of IP&R operational assessments for use by Pacific Island Nation Governments to gain a deeper understanding of the issues that may be impacted under Nautilus' current published operating plans and partnership agreements. Finally, M·CAM recommends further regulatory action in PNG to adopt appropriate guidelines based on ISA or other regulatory practices including seafloor video feeds and instrument auditing. Measurable continuation of biodiversity should also be required.



## **Appendix I: Regulatory Systems**

Adopting some or all of the following recommendations could help insure proper methods and procedures to be implemented and observed regarding Deep-Sea Mining of Massive Sulfide Deposits.

In the Guidelines adopted by the International Council for the Exploration of the Sea (ICES) it is suggested that the minimum requirements for the monitoring system should include, inter alia, an automatic record of the date, time and position of all aggregate dredging activity; position to be recorded to within a minimum of 100 meters in latitude or other agreed coordinates using a satellite-based navigation system; that the frequency of recording position should be appropriate to the status of the vessel. It is also pointed out that the information gathered via the monitoring program can also be used by the companies to improve utilization of resources. In addition, the information will also be an important input into the design and development of appropriate environmental program and research into the physical and biological effects of extraction/mining.

The International Council for the Exploration of the Sea (ICES) general principles for the sustainable management of all mineral resources includes:

- conserving minerals as far as possible, whilst ensuring that there are adequate supplies to meet the demands of society;
- encouraging their efficient use (and where appropriate re-use), minimizing wastage and avoiding the use of higher quality materials where lower grade materials would suffice;
- ensuring that methods of extraction minimize the adverse effects on the environment, and preserve the overall quality of the environment once extraction has ceased;
- the encouragement of an ecosystem approach to the management of extraction activities and identification of areas suitable for extraction;
- Protecting sensitive areas and important habitats (such as marine conservation areas) and industries (including fisheries) and the interests of other legitimate users of the sea.

The monitoring requirements set out in the Guidelines issued by the Helsinki Commission are more detailed, particularly concerning monitoring of chemical and biological parameters. The

guidelines state that monitoring shall be a component of every kind of extraction activities and include the following:

- Dredging & Deep-Sea Mining equipment, ROVs and all vessels should be equipped with monitoring systems for recording the position and the amount of extracted sediments;
- Spill monitoring shall be carried out, including amount and composition of spill; dispersion of suspended particles of the turbidity plume; sedimentation pattern; biological parameters (plankton, fish, sea birds etc.), as appropriate;
- Depending on the extracted material monitoring may also be necessary for oxygen and nutrients in the spill water, in the water column at the extraction site and in the turbidity plume;
- If the sediment contains harmful substances and release by the excavation process has to be assumed the monitoring shall also include these parameters;
- After termination of the extraction the recovery of benthic communities shall be monitored as defined in the EIA.

In 1999, the South Pacific Applied Geosciences Commission (SOPAC) adopted the Madang Guidelines as a blueprint for offshore mineral policy in the Pacific. The Key Principles of the Madang Guidelines include the following:

- Coastal States should move rapidly to stake claims for extending their continental margins.
- Nations should minimize the potential adverse impacts of offshore mining on marine environment and on other users of the sea.
- All exploration licenses should be conditional upon the collection of baseline environmental data.
- Coastal states should develop offshore mining policies and legislation that are separate from those of inland mining.
- Nations should ensure that Marine Scientific Research can produce research data while protecting the confidentiality of investors.
- Coastal states representatives should participate in all at-sea research and exploration to ensure effective monitoring.

- Marine Scientific Research and the industry should ensure adequate understanding of the life forms associated with actively venting chimneys.
- Coastal states should consider the risks involved in seabed mining in the development of licensing and fiscal regimes.
- All commercial offshore operators must carry appropriate insurance.

The International Marine Minerals Society in 2001 adopted a Code for Environmental Management of Marine Mining. It consists of a set of Operating Guidelines for application as appropriate at specific mining sites. The goals below are followed by the more specific Operating Guidelines for corporate responsibilities. Member companies have committed themselves to these six principles:

- To observe the policies, and respect the aspirations, of sovereign governments and their regional sub-divisions, and of relevant international agencies, as appropriate to underwater mineral developments;
- To apply best practical procedures for environmental and resource protection, with consideration for future developments within the area which might be affected;
- To consider environmental implications through all stages, from exploration through development and operations to eventual closure;
- To facilitate community partnerships on environmental matters;
- To maintain an environmental quality review program; and
- To report publicly on environmental performance and implementation of the Code

The Operating Guidelines of the Code for Environmental Management of Marine Mining (by the International Marine Minerals Society), contain the following general principles, with lists of a number of very specific guidelines to operate in accordance with:

- **On Sustainable Development:** Manage activities in a manner consistent with sustainable development of the operating area, such that economic, environmental and social considerations are integrated into decision-making and management.
- **On Community Partnership:** Consult interested communities on their concerns, aspirations and values regarding development and operation of marine mining projects,

recognizing that there are links between environmental, socio-economic and cultural values.

- **Environmental Risk Management:** Apply risk management techniques site-specifically to identify environmental risks, their possible consequences, and their probabilities of occurrence.
- **On Integrated Environmental Management:** Recognize environmental management as a company priority and integrate environmental management into all operations from exploration, through design and construction to mining, minerals processing, rehabilitation and decommissioning.
- **On Company Environmental Performance Targets:** Set environmental performance targets not necessarily limited to the requirements of directly applicable legislation, regulations, licenses and permits. Specifically:
- **On Environmental Improvement and Upgrading:** Implement management strategies to meet current and anticipated standards and regularly review targets in the context of changing needs and aspirations.
- **On Rehabilitation and Decommissioning:** Ensure that decommissioned sites are rehabilitated and left in a safe and stable condition, after taking into account beneficial uses of the site and surrounding seabed.
- **On Reporting and Documentation:** Demonstrate commitment to the Code's principles by reporting on the company's implementation of the Code and its environmental performance. Make reports publicly available, particularly to regulatory agencies, the community and within the Company.
- **On Archiving:** Ensure future availability of environmental information and collections gathered (other than proprietary technical information) for international scientific understanding, or for national heritage use.
- **On Performance Reviews:** Regularly evaluate Company performance of the Environmental Code by qualified, externally-accredited environmental auditors from within the adopting Company, or by externally-accredited environmental auditors appointed by the Company. Performance reviews are to be conducted and reported by the company at least every three years.

Within the framework of the GPA PADH program, to extend policy support to governments, UNEP has developed a set of Key Principles and Checklists for Coastal Mining Development. These principles and checklist items have been distilled from the available guidance and focus on aspects of mining that are most relevant to minimizing physical alteration, destruction of habitat and sediment mobilization. The principles and checklists represent the normative component of the GPA PADH program and are intended to:

- Increase understanding and recognition of actions necessary to minimize the impacts of aquaculture, tourism, mining and port development on the coastal zone. Physical alteration and habitat destruction and sediment mobilization resulting from these impacting activities are the main focus attention.
- Provide direction in the development of these economically important sectors so that they do not in any way hamper environmentally sustainable development within the coastal zone.
- Serve as consensus guide to national and sub-national decision makers and the stakeholders in the industry to minimize physical alteration and habitat destruction.

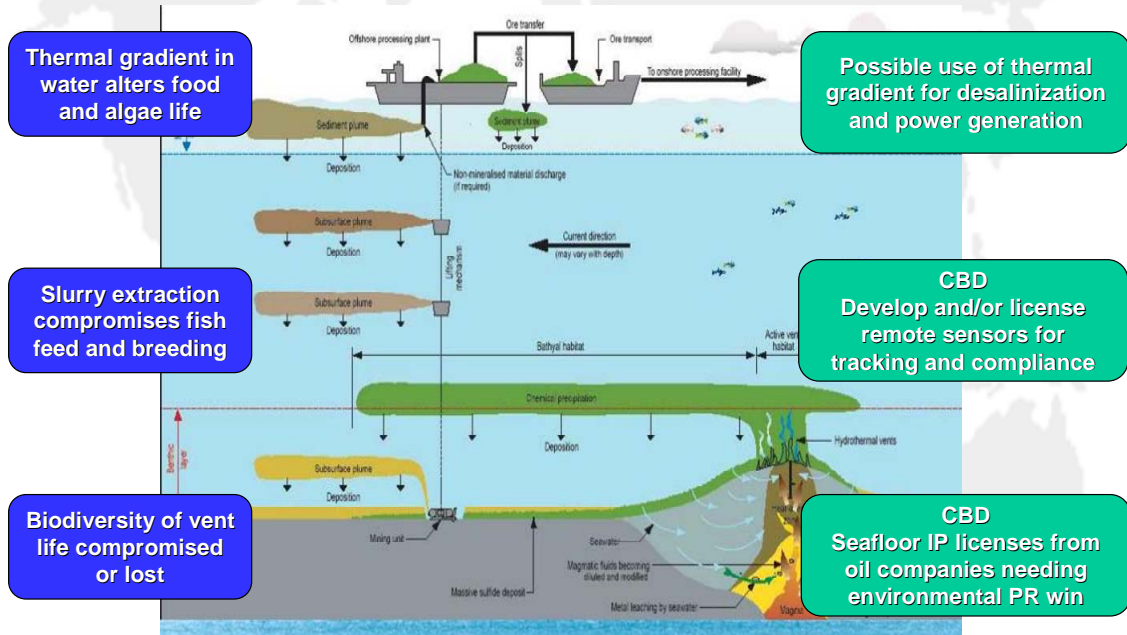
The 9 PADH Key Principles for Coastal Mining Development are:

1. Implementation of sustainable development principles in the coastal mining sector require integrated systems of governance.
2. Sustainable development requires a management framework including a mix of regulatory mechanisms, financial incentives and voluntary initiatives.
3. Through the application of EIA, seek consistency with national environmental priorities and continual improvements to environmental management.
4. Both large and small-scale sand mining within the coastal zone should be carefully regulated and monitored.
5. Restoration and rehabilitation of mining sites demand priority attention of both the developer and the regulating authority.
6. Sustained monitoring program that assess the performance of the coastal mining sector during the project cycle and post project rehabilitation is indispensable.

7. Capacities within state institutions, the industry and local communities to work towards ecologically and socially sustainable coastal mining should be enhanced.
8. Regional and International organizations should strive to improve environmental performance in the coastal mining sector.
9. Capacities within state institutions, the industry and local communities to work towards ecologically and socially sustainable coastal mining should be enhanced.

## Appendix 2: Potential Environmental Stresses During Mining

### Sources of Environmental Challenge



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