

DEEP-SEA MINING IN PAPUA NEW GUINEA: POLICY FRONTIER

by

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## **ABSTRACT**

Ratification of the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and its deep-sea mining Implementing Agreement of 1994 form the framework for the International Seabed Authority (ISA) Mining Code. The major repercussion of the UNCLOS/ISA mining policy is that the severity of the regulations caused mining entities to focus their efforts in Exclusive Economic Zones (EEZs). Governments of possible sites may or may not have policies addressing deep-sea mining activities. A commercial mining first occurred in 1997 when the Papua New Guinea (PNG) Government granted offshore exploration licenses to Nautilus Minerals Niugini, Ltd. This project utilizes a holistic analysis strategy to examine developing deep-sea mining events in Manus Basin, Papua New Guinea. The many challenges and issues of these events illustrate the complicated link between science and policy. Deep-sea mineral resources have yet to be exploited but doing so could help alleviate humanitarian issues in PNG. Regional legislation for deep-sea mining exists in PNG and is being refined as events progress; however, PNG legislation does not exist for some related issues. In these situations, Nautilus is adopting international standards and/or relevant Australian policies. The people of Papua New Guinea and the southwest Pacific are in a unique position to be proactive, not reactive, about how vent mineral resources will be exploited and avoid risking the treasure of the vents themselves for the sake of the resource treasure.

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## INTRODUCTION

Nautilus Minerals Niugini, Ltd. (Nautilus) was granted offshore mineral and exploration licenses by the Papua New Guinea (PNG) Government in 1997 - a first in commercial mining worldwide - and has been exploring the seafloor of PNG territorial waters since then for gold, copper, zinc, and silver sources called polymetallic massive sulfide deposits (Herring 2002, Montgomery 2003, *Nautilus Minerals Online* 2006, United States 2007, “Papua New Guinea Fact Sheet” 2008). The Australian Commonwealth Scientific and Industrial Research Organization (CSIRO) discovered the area named Solwara I in 1996 (Nautilus with Coffey 2008). Solwara I is bordered on the north by the island of New Ireland and to the south by the island of New Britain. The site is located at a depth of 1700 m in Manus Basin and contains highly marketable ore (Fig. 1, *Nautilus Minerals Online* 2006, Collins et al. 2007, “Company Fact Sheet” 2008). The company hopes to obtain permission from the PNG Government to begin mining at Solwara I in 2010 (“Papua New Guinea Fact Sheet” 2008). In PNG waters alone, tenement coverage for Nautilus spans 205,000 km<sup>2</sup>. Thirty-three exploration licenses have been granted, and another 57 tenements have been applied for as of 31 March 2008 (Fig. 1, *Nautilus Minerals Online* 2006).

Nautilus is exploring with a 111-hole Remote Operated Vehicle (ROV) core drill that can drill 19 m deep and a new technique, Deep-ocean Electromagnetic Exploration, that is a targeting and testing tool to increase exploration efficiency. The three main components of the proposed Nautilus mining system are the Seafloor Mining Tool (SMT) that has a production rate of 6000 tons day<sup>-1</sup>, the Riser and Lifting System (RALS), and the 160 m specially designed Mining Support Vessel. The SMT will cut the seafloor,

suction that material inside itself as slurry, and then transport the slurry to a pumping module. The slurry will be pumped up a riser pipe to the Mining Support Vessel. Once on board the slurry will be dewatered, continuously transferred to barges, and then shipped to an existing facility nearby at the Port of Rabaul to be held until it is shipped to an overseas plant (Fig. 2, *Nautilus Minerals Online* 2006, Nautilus with Coffey 2008).

Nautilus Minerals has identified the following potential mining impacts: Material and habitat removal with regards to the seafloor, plume generation and the associated water quality disturbance from cutter head and from return water, noise and/or the associated vibrations on the seafloor and at the surface, fuel and water resource use, and spillage potential (*Nautilus Minerals Online* 2006). Other potential impacts have also been identified including the following: Social disturbance will be limited since it is not a land-based operation, mining infrastructure will be kept to a minimum as production will occur offshore, overburden or stripping will not be required since the ore occurs on the seafloor, mining waste will be minimal since the extraction of high-grade ore is relatively precise, and workers will be spared from being exposed to typical mining conditions (*Nautilus Minerals Online* 2006).

A variety of experts was included in the data-gathering process, and an extensive Environmental Impact Statement (EIS) is based on the results of their studies (*Nautilus Minerals Online* 2006, Nautilus with Coffey 2008). The Statement addresses potential impacts and describes impact mitigation measures (Nautilus with Coffey 2008). For example, people along the PNG coast are concerned about marine environment quality as this affects traditional activities and subsistence needs (“Deep-sea Mining Proposals” 2007, “Indigenous Communities” 2008, Nautilus with Coffey 2008). Nautilus states that



sewage will be treated in accordance with the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL); oils, chemicals, and garbage will be treated and disposed of on shore; and drainage to treatment tanks will be utilized on deck areas where oils and chemicals will be used. Bioaccumulation of heavy metals and the corresponding affects on tuna fisheries is also a concern and will be addressed by discharging water from the dewatering process between 25 m to 50 m above the seafloor (Nautilus with Coffey 2008). Socioeconomic impacts including economic benefits, community development, and the potential for the ineffective distribution of benefits are also addressed. For example, Nautilus is implementing a recruitment policy that is expected to support opportunities for local people while deterring migrants in an effort to ward off a whole host of related issues (Nautilus with Coffey 2008). Nautilus is establishing a Community Development Fund to aid existing healthcare and education programs. Total direct economic benefits are estimated to be US \$142 million with approximately US \$2 million (*Currency Converter* 2009) being directed into the Fund (Nautilus with Coffey 2008).

Regional legislation for deep-sea mining exists in PNG and is being refined as events progress (South Pacific 1999, “Ocean and Islands” 2005, Papua New Guinea 2005). Legislation regarding some related issues including air quality and noise, specifically how noise affects marine animals does not exist at this time in PNG. In these cases, Nautilus is adopting international standards such as the Equator Principles and the International Finance Corporation’s Performance Standards on Social and Environmental Sustainability, and/or the Australian Standards and other relevant Australian policies (*Nautilus Minerals Online* 2006, Nautilus with Coffey 2008).

The International Seabed Authority (ISA) does not have jurisdiction in a nation's Exclusive Economic Zone, nor does the Authority have regulations regarding polymetallic sulfide and cobalt-rich crust exploration activities in the high seas at this time (International Seabed Authority 2000, *Mining Code* 2008). These regulations are in the works, rendering the ISA Mining Code incomplete (*Mining Code* 2008). The ISA is supportive of PNG policy and is interested in events there as a case study (Birney et al.). The events occurring in PNG could set a precedent for future mining operations worldwide.

This project examines developing deep-sea mining events in Manus Basin, Papua New Guinea; considers the challenges and issues of these events; and provides recommendations for policy implementation. The Background gives a concise history of deep-sea mining, and briefly explains why hydrothermal vents are of interest to mining companies. Major legal mandates related to deep-sea mining in PNG are discussed in the Legal Mandates section. The total ecology involved with this issue is described in its respective section; total ecology being defined as the non-human environment and resources involved, human beings that affect or are affected by deep-sea mining in PNG, and governing institutions that affect human behavior (Orbach 1995, Cicin-Sain et al. 1998). An analysis of possible policy alternatives will be presented followed by an exploration of policy recommendations and their rationale.

## **BACKGROUND**

### **Deep-sea mining: A concise history**

Manganese nodule extraction from deposits on the high seas was the initial deep-sea mining interest (Halfar et al. 2007). Deep-sea mining efforts between 1960 and 1984 proved to be a disappointment. Companies in the United States, Germany, France, Britain, and Japan collectively spent about US \$650 million for mining technology development and manganese nodule exploration; however, minimal profit was generated (Glasby 2000). Low metal prices and the ratification of the United Nations Convention on the Law of the Sea (UNCLOS) in 1994 further tempered mining interests (Halfar et al. 2007).

The 1982 UNCLOS and its deep-sea mining Implementing Agreement of 1994 form the framework for the International Seabed Authority (ISA) Mining Code (*Mining Code* 2008). The major repercussion of the UNCLOS/ISA mining policy is that although the ISA has issued seven deep-sea bed leases in the high seas area the severity of the regulations caused mining entities to focus the majority of their efforts in Exclusive Economic Zones (EEZs) (Halfar et al. 2002, Halfar et al. 2007, *International Seabed Authority Online* 2009). In these zones, the respective nation has the responsibilities of issuing mining licenses and defining environmental safeguards (Halfar et al. 2007). The International Seabed Authority has no jurisdiction in EEZs (Halfar et al. 2002); the Authority only has jurisdiction in international waters of the high seas (*Mining Code* 2008). Consequently, companies are spared the associated technology transfer and environmental regulations as well as the fees that characterize the ISA policies and regulations (United Nations 1982, United Nations 1994, Halfar et al. 2002, Halfar et al.

2007, *Mining Code* 2008). Some governments who have jurisdiction over massive sulfide deposits have been slow to craft environmental regulations regarding the mining issue (Halfar et al. 2002, Halfar et al. 2007).

### **Geology and chemistry of back-arc basins**

Hydrothermal vents are the ocean's version of hot springs. They are distributed worldwide and are located on the seafloor along mid-ocean ridges. Mid-ocean ridges are underwater mountain chains that circle the planet similar to the way seams circle a baseball. These ridges are located at tectonic plate boundaries and are therefore associated with seafloor spreading (Fig. 3, Van Dover 2000, Herring 2002, Koslow 2007).

Vents are where hot water emerges on its return trip through the crust. The temperature of the water coming from these hot springs ranges from 10-350° C (Castro et al. 2003). Geothermal processes heat the water that seeps through the crust. Carbon dioxide is formed when oxygen combines with seawater as seawater approaches the magma chamber. The water becomes acidic with pH ranging from 3 to 5, because sulfate has been reduced to sulfide. Metals such as copper and zinc are leached out of the basalt as the water continues to approach the vent opening. When this water emanates from the vent opening it contains a lot of heavy metal solutes, because other minerals have been dissolved out by the extreme water temperature and pressure. The solutes that remain are spewed out with the extremely hot water at vent openings and then precipitate out as the hot vent mixture reacts with the cold ambient water. This reaction results in black plumes that contain sulfides and anhydrite, or white plumes resulting from relatively cooler vent fluids emitting silica and barite, and the accumulation of spewed minerals into columns

that can reach a height of 45 m (Herring 2002, Koslow 2007). Other metals precipitate out of solution farther away and are deposited on the seafloor (Fig. 4, Koslow 2007).

Areas where vent water is mixed with and diluted by the surrounding cold water are typically the biologically active areas, because complex vent food webs are supported by chemosynthetic primary production (Van Dover 1990). The oxygen in seawater is the oxidant in the chemosynthetic process in which energy is produced from sulfide oxidation (Boyle 1985, Jannasch et al. 1985, Pirie 1985, Van Dover 2000). Chemosynthetic archaea and bacteria oxidize hydrogen sulfide to form sugar (Desbruyeres et al. 1994, Herring 2002, Castro et al. 2003).

Some vents are isolated from other vents because they developed behind volcanic arcs on back-arc segments (Van Dover 1990). Back-arc basins, found mostly in the western Pacific, are formed when sinking oceanic crust pulls on continental crust that is going in the same direction. Pulling results in tension and a split occurs in the continental crust. Magma upwelling and the resulting crust accumulation can occur if there is enough heat (Fig. 5, Hessler et al. 1988, Stern et al. 1990, Van Dover 2000). Manus Basin is one such basin (Galkin 1997). Specific characteristics of this basin will be discussed in the Findings section.

## **METHODS**

This project is a case study focusing on events surrounding deep-sea mining in Manus Basin, Papua New Guinea. Information was collected from the Nautilus Minerals company website, government publications, journal articles, manuscripts, and books. This information was used to describe the historical background of deep-sea mining in general and deep-sea mining in Papua New Guinea. With respect to deep-sea mining in PNG the information was used to introduce key actors, their roles, and their motives, and to describe the major policies involved. A holistic analysis strategy was used to identify major themes of the case study events.

## **FINDINGS**

### **Legal Mandates Related To Deep-sea Mining in Papua New Guinea**

The major legal mandates related to deep-sea mining in Papua New Guinea are the Mining Act 1992, the Mining Safety Act 1977, the Mineral Resources Authority Act 2005, and the Environment Act 2000. Mineral and mining law is contained in the Mining Act 1992, which states that minerals that are in PNG territory in any way, including territorial waters are the property of the State. This Act also states that unless a person is a PNG citizen who is using hand tools to mine on his or her own land, then that person has to be authorized by the Minister of Mining to conduct exploration or mining activities (Independent 1992, Papua New Guinea 2005). Provisions regarding licensing, fees, rents, royalties, landholder compensation, and other issues are explained (Independent 1992) and the administrative structure that is to implement this Act is also described (Independent 1992, Papua New Guinea 2005). As of this writing, the administrative structure as originally described has been altered per the mandates in the Mineral Resources Authority Act 2005 and the recent enactment of the Mineral Resources Authority discussed below.

Mine and work regulation and inspection are covered in the Mining Safety Act (Independent 1977, Papua New Guinea 2005). This Act is considered part of the Mining Act 1992. Topics vary and include inspector appointments and powers, mine management and supervision prerequisites and responsibilities, employment conditions, storage of mine plans, and safety and accident procedures (Independent 1977).

The purpose of the Mineral Resources Authority (MRA) Act 2005 is not to replace the Mining Act 1992, but to provide guidelines for the development of new

mining sector governance and administrative structures. The main goal is to curtail corruption and limit opportunities for abuse that have occurred previously. The MRA Act 2005 specifies appointment and termination processes with regards to the Managing Director, prerequisites for Board appointments, and strict maintenance of accounting records among other such processes (“Corporate Profile” 2008).

The Environment Act merged a number of environmental acts. This Act recognizes that the physical and social environments are impacted by mining operations and requires impact assessments for these activities. Generally, whatever harm is going to be inflicted on the environment because of a certain activity has to be minimized or prevented before the activity is performed (Independent 2001, Papua New Guinea 2005). An exploration license allows the holder to do whatever is necessary to conduct mineral exploration provided that those actions comply with the Environment Act 2000 (Papua New Guinea 2005). The powers of the Director of Environment, establishment guidelines and appointment procedures of the Environment Council, and the role of the Council are also detailed in this Act (Independent 2001).



## **Total Ecology of Deep-sea Mining in Papua New Guinea (Fig. 6)**

### *Biophysical ecology*

Papua New Guinea, a country made up of over 600 islands that are populated by a diverse population of 6.2 million people (*Papua New Guinea* 2007), is located in the southwest Pacific Ocean from latitude 10° South to the equator (Papua New Guinea 2005). PNG is situated in the Ring of Fire between the oceanic Pacific Plate to its north and the Indo-Australian Plate to its south (Papua New Guinea 2005, *The World Factbook* 2008). This placement along an area of such tectonic activity renders the country susceptible to a host of threats including active volcanoes such as the 1994 Tuvuvuv eruption that destroyed the town of Rabaul, and tsunamis such as the three waves that devastated northeastern PNG on 17 July 1998 (Montgomery 2003, “Ocean and Islands” 2005, Papua New Guinea 2005, *The World Factbook* 2008). That same tectonic activity also contributes to the natural resource richness and diversity of PNG (Papua New Guinea 2005, *Papua New Guinea* 2007, United States 2007).

Manus Basin is located north of PNG in the Bismarck Sea (Galkin 1997) and contains several areas of hydrothermal activity and vent communities (Hashimoto et al. 1999). As mentioned in the Introduction, a product of hydrothermal activity is the production of gold, copper, zinc, and silver sources called polymetallic massive sulfides (Herring 2002, Montgomery 2003, “Papua New Guinea Fact Sheet” 2008). A variety of organisms also inhabit Manus Basin vent sites. Some of these organisms such as the dominant snails of *Alviniconcha* spp and *Ifremaria nautilei* and barnacles of *Eochionelasmus* spp form a zonation pattern - presumably due to temperature and fluid chemistry gradients - around a given host vent (Fig. 7, Nautilus with Coffey 2008).

Organisms such as crabs, shrimps, squat lobsters, and polychaete worms utilize the zonation patterns as habitat (Nautilus with Coffey 2008). Other organisms such as a species of the tubeworm *Alaysia* and two species of *Alviniconcha* are new-to-science (Johns et al. 2007, Nautilus with Coffey 2008). *Bathymodiolus manusensis* is a mussel that is featured only in Manus Basin, specifically at the proposed reserve South Su (Fig. 8, Nautilus with Coffey 2008). Fish observed around the vent site include cartilaginous *Chimaera* spp and the blobfish *Psychrolutes marcidus* (Nautilus with Coffey 2008). Stalked barnacles *Vulcanolepas parensis* (Fig. 9), carnivorous sponges of *Abyssocladia* spp, and corals of *Keratoisis* spp (Fig. 10) are among the characteristic organisms of inactive hard surfaces away from vent sites (Nautilus with Coffey 2008). Overall, Manus Basin organism densities are lower in comparison to other vent sites worldwide (Nautilus with Coffey 2008). Manus Basin vent communities offer the opportunity for biogeographical studies, more specifically faunal exchange among western Pacific hydrothermal vents, since Manus Basin is located between the Mariana Trough and the North Fiji Basin (Galkin 1997, Hashimoto et al. 1999, Van Dover 2000, Collins et al. 2007).

#### *The role of the mining industry in Papua New Guinea*

The prosperity of PNG is impacted by the success of the PNG mining industry, which has been making the most significant contributions to the PNG economy since the 1970s (“Corporate Profile” 2008). Two major events helped boost the mining industry of PNG: PNG gained its independence in 1975 and the price of gold rose in 1974 followed by an even greater rise in 1979. International companies bombarded the Department of Mining with exploration license applications, and the mining industry became a major

force (Papua New Guinea 2005). Approximately 83% of the country's total export earnings in the year 2006 were accredited to the export value of minerals. This value totaled US \$3.4 trillion. PNG consistently produces considerable amounts of copper and since the beginning of this century has been the world's 11<sup>th</sup> largest gold producer. Copper production is expected to exceed 195,000 tons per year through 2013, while gold production is expected to exceed 70 tons per year through 2013. However, not all identified reserves are being mined due to the difficult terrain of the country and infrastructure development costs as mentioned below (Papua New Guinea 2005, *Papua New Guinea* 2007).

#### *Human ecology part A*

Regardless of the country's diverse population, its economic growth of late, and its plentiful natural resources of gold, oil, gas, copper, silver, timber, and fisheries, estimates indicate that over half the population lives in poverty (*Papua New Guinea* 2007). The terrain as well as infrastructure development costs are obstacles to natural resource exploitation. The national budget is now stable after years of political and social issues such as corruption, high unemployment, and high crime rates, but recovering investor confidence and re-establishing integrity to state institutions are two of the many challenges that PNG continues to confront (*Papua New Guinea* 2007, *The World Factbook* 2008). Mines are found by exploration activities. High levels of exploration are needed to sustain PNG mining industry success. The challenge for the PNG Government is to extend the lifetime of existing mines and to increase exploration and the number of operational mines ("Corporate Profile" 2008).

#### *Institutional ecology*

Mineral exploration and mining activities were originally regulated, monitored, promoted, and recorded by the Papua New Guinea Department of Mining (DOM) (Independent 1992, United States 2007). The DOM, through staff shortages and a decreasing budget, was deemed “inadequate to respond” to the complex issues that mining project development generates (“Corporate Profile” 2008). The Mineral Resources Authority (MRA) is better situated to attract and retain staff and to financially carry out its duties because it is designed to sustain itself financially by a production levy on all minerals obtained from mining activities instead of relying on allocations from the National Recurrent Budget. The Mining Act 1992 is the basis for the many functions of the MRA. In addition to advising the Minister on all things mineral in PNG, the Authority will also carry out social needs programs such as poverty alleviation and ground water supply (“Corporate Profile” 2008).

The MRA consists of a Board of Directors, a Managing Director, and five divisions. This type of structure is supposed to separate the financial interests from the policy and regulation interests (Fig. 11, “Corporate Profile” 2008). The MRA Board oversees the institution that administers mining regulations and is unique in that its powers are limited to regulation as opposed to other Boards that have regulation and permit/license issuing responsibilities. The Minister for Mining issues licenses per recommendations by the Mineral Advisory Board (“Corporate Profile” 2008). Four members of the MRA Board of Directors represent public interests, four members represent private interests, and the ninth member is the Managing Director. Three of these nine members have former experience with the Department of Mining. With respect to mining regulation or policy matters, the Managing Director is accountable to the

Minister. With respect to general administration issues such as budgeting and staffing, the Managing Director is accountable to the Board. An annual report and an annual audit report are required to be submitted from the Board to the Minister, who then presents the information to Parliament (“Corporate Profile” 2008).

The MRA is composed of five divisions that are directed by their own Executive Manager who reports to the Managing Director. The divisions are Development Coordination, Information and Marketing, Regulatory Operations, Geological Survey, and Corporate Services. At the time of this writing, three of the five Executive Manager positions – Regulatory Operations, Information and Marketing, and Development Coordination – are vacant. One of the two Executive Managers has previous experience with the Department of Mining. Branch Managers report to the Executive Managers (“Corporate Profile” 2008).

The Regulatory Operations Division enforces mining legislation (“Corporate Profile” 2008) and so will be the only division discussed in detail in this paper. The Regulatory Operations Division is responsible for administering the Mining Act 1992 and the Mining Safety Act 1977. To facilitate this role, the Division is subdivided into The Office of the Registrar, The Office of the Chief Warden, and The Office of the Chief Mines Inspector. The first two offices focus on enforcing the Mining Act 1992. The Office of the Registrar provides legal and technical advice with regards to tenement applications, processes tenement and exploration applications, and keeps a register of the tenements. The Office of the Chief Warden carries out a magistrate role and also serves as an arbitrator during exploration hearings. The Office of the Chief Mines Inspector enforces the Mining Safety Act (MSA) 1977 (*Mineral Resources Authority* 2008). The

mine manager, who is appointed by the mine owner, enforces the MSA on a day-to-day basis. Enforcing in this instance means reporting breaches to an Inspector. The Chief Inspector and other Inspectors are appointed by the Minister and actually visit the mines on a regular basis to inspect, provide corrective instruction, and order operations to stop when necessary (Independent 1977, *Mineral Resources Authority* 2008).

The Environment Act 2000 is presently being administered by the Department of Environment and Conservation (Nautilus with Coffey 2008). This Act is supposed to be enforced by the Environment Council; however, the Council has not been established as of the time of this writing (Papua New Guinea 2005). The Minister of Environment appoints Council members. One of those members is the Director of Environment. The Director has several responsibilities including enforcing the Environment Act 2000, issuing permits, and performing environmental audits and investigations. Five other members complete the Council and each of these members specialize in environmental disciplines such as environmental chemistry, environmental policy or law, sustainable resource use, conservation, and socio-economics. These five members advise the Director on environmental matters and the Council as a whole advises the Minister of Environment on policy-making matters (Independent 2001).

Despite the vacancies in the governing bodies, progress is being made on the industry side of the issue. Nautilus Minerals has submitted and the PNG Government has accepted the Environmental Impact Statement (EIS) for the Solwara I Project. This acceptance serves as confirmation that the document complies with Environment Act 2000 submission requirements, specifically that possible impacts have been described, all reasonable measures will be taken to minimize those impacts, and that the activity and

relevant environmental policies are in agreement with each other to the Director's satisfaction. As of 6 November 2008, the Statement is up for review by the PNG Government and the public. Nautilus has developed a webpage to make the process more transparent (Independent 2001, *Nautilus Minerals Online* 2006).

### *Human ecology part B*

Not everyone approves of deep-sea mining in the region. Nautilus Minerals received a formal letter of concern from representatives of tribal coastal villagers during the week of 2 October 2007. The representatives were requesting the opportunity for additional community participation and a broader Environmental Impact Statement. The villagers' argument was simple: They depend on the ocean as a food source and do not want to risk losing it by rushing into deep-sea mining ("Deep-sea Mining Proposals" 2007).

The Bismarck Solomon Seas Indigenous Peoples Council issued a statement on 25-27 June 2008, which declared their customary rights, listed reasons for their concern, and called for those involved with the mining operations to stop until the Indigenous Peoples' concerns were not only addressed but resolved to their satisfaction. Seventy people serving as tribe and association representatives signed the Statement ("Indigenous Communities" 2008). Generally, the indigenous groups are concerned that the impacts from the mining activities will derange the coral ecosystems on which they depend and, therefore, negatively impact their health, livelihoods, and lifestyle ("Deep-sea Mining Proposals" 2007, "Indigenous Communities" 2008).

## **DISCUSSION**

### **Analysis of Policy Alternatives**

The Madang Guidelines are 19 recommendations such as the collection of baseline environmental data and the continued collection of data throughout the life of an exploration license that address issues related to policy development and legislation regarding offshore mineral exploration and possible development in Exclusive Economic Zones (EEZs). The South Pacific Applied Geoscience Commission (SOPAC) designed the Guidelines to serve as a template for nations preparing their own offshore mineral policy and address impact assessment, stakeholder interests, research, and other issues. The Guidelines emphasize the full implementation of UNCLOS provisions within individual jurisdictions and stress that countries clarify their territorial boundaries and be aware of the boundaries of other countries. Conservative mining measures are encouraged and the development of an Offshore Mining Act is recommended (South Pacific 1999). Possible impacts of having an offshore mining policy as put forth by the Guidelines include a national economic return of maximal value, a timely and conservative mining process, and a resource diversification framework. Ideally, the Guidelines seek to make sure that all stakeholder interests are met and that the least possible physical and social damage is encountered in the process (South Pacific 1999).

The International Marine Minerals Society's Code for Environmental Management of Marine Mining draws from many sources including government and industry documents, for example the Madang Guidelines, and reviews from marine scientists to offer general principles and operation guidelines to be followed before, during, and after mining. The Code is intended to benefit industry with respect to project



development, benefit regulatory agencies with respect to policy development, and benefit stakeholders with respect to evaluating a company's environmental actions (International Marine Minerals Society 2001). Emphasis is placed on proactiveness, transparency, and adaptability. The Code encourages a proactive mindset by suggesting that a company should, among other things, educate its employees at all levels as well as the community about that company's environmental policies and their application. Transparency is also a trademark of the Code as the Code calls for regular consultations with affected communities and for regular performance reports to be written and made publicly available. The Code recommends that management strategies be adaptable in light of evolving needs and standards (International Marine Minerals Society 2001). Possible impacts of a company adhering to the Code include having a more informed staff and having a viable benchmark for evaluating environmental performance. Likewise, government agencies and stakeholders have a benchmark for evaluating company performance and governments have a viable framework for deep-sea mining policy (International Marine Minerals Society 2001).

The Madang Guidelines and the Code for Environmental Management of Marine Mining are voluntary. They are only considered binding to the entity that adopts them. Even then, the underlying assumption is that these rules or guidelines will be followed. The Guidelines and the Code stress a conservative/precautionary approach to mining and forward thinking about impacts and how to keep those impacts to a minimum, if not eradicate them altogether (South Pacific 1999, International Marine Minerals Society 2001). Eradicating impacts is a high ideal, but it is never actually possible – there will always be some impact from mining. Keeping impacts to a minimum is more likely. The

question at this point is, “What is the minimum?” Herein is the complicated link between science and policy. Although scientific studies can convey some knowledge regarding the risks, costs, and/or benefits of an action, “everything is politics” (Orbach 2008) which means that science is not – nor should it be - the only factor that will determine a given decision (Kriebel et al. 2001). Science provides data and information on the basis of which tradeoffs are made among various objectives, for example the desire to extract minerals and the desire to avoid environmental impacts. Scientific studies are a double edge sword. Just as scientific studies can convey knowledge, they can also clarify what is not known and will always be haunted by a degree of uncertainty (Kriebel et al. 2001). Since decisions will always be made in the light of some uncertainty, one must consider that while one impact or risk is being avoided, another impact or risk is being accepted (Goldstein 1999, Kriebel et al. 2001).

And so the environmental “whack-it game” continues. Not mining means in part salvation of the vents – at least for now - while the humanitarian issues go unresolved. On the other hand, mining could help alleviate regional humanitarian issues (“Corporate Profile” 2008, Nautilus with Coffey 2008) although the impacts to the marine environment are not fully understood. The situation is both a conundrum and an opportunity.

## **Recommendations and Rationale**

I propose that Nautilus and the PNG Government proceed as planned with the mining project on the grounds that uncertainty regarding the extent of impacts is no excuse for not mining especially when humanitarian issues are involved and mining could help alleviate those issues. As discussed previously, the PNG Government has instituted social programs such as poverty alleviation and ground water supply through the Mineral Resources Authority (“Corporate Profile” 2008) and Nautilus is establishing a Community Development Fund to aid existing healthcare and education programs (Nautilus with Coffey 2008).

I also propose that the vacancies in the Mineral Resources Authority be filled as quickly as possible and that the development of the Environment Council be completed as quickly as possible. As with any other legislation, monitoring and enforcement are key. The Mineral Resources Authority and the Environment Council are the enforcing bodies of the respective acts as previously discussed (Independent 2001, Papua New Guinea 2005, “Corporate Profile” 2008). The industrial components of the total ecology are forging ahead with their venture (*Nautilus Minerals Online* 2006). Since deep-sea mineral resources have yet to be exploited, this is an opportunity for the institutional/legislative components of the total ecology to be proactive, not reactive, about how this resource will be exploited.

I further propose that an offshore mining policy be developed as recommended in the Madang Guidelines. The hydrothermal vent environment is complex and dynamic (Desbruyeres et al. 1994, Koslow 2007). The policy should address these biophysical issues as well as all aspects of human ecology including the impact of mining on

stakeholder interests (South Pacific 1999). Since the Guidelines seek to allow a nation the greatest economic profit while conserving the environment (South Pacific 1999), and since the MRA will also be engaged in social needs programs (“Corporate Profile” 2008), development and enforcement of an offshore policy has the potential to expedite social relief in the nation through revenues/economic rents of direct taxes, indirect taxes, and tax incentives (South Pacific 1999) channeled through the MRA social programs.

## CONCLUSION

Deep-sea mining is a complicated issue. On the surface, the events in PNG seem like a race between industry and government with other stakeholders such as non-governmental organizations and the Indigenous Peoples Council to see whose interests will be represented in the policy outcome. I argue that several dramas are playing themselves out. Industry interests do want to make money but they are trying to go about mining in a responsible way by collaborating with experts worldwide in developing a thorough Environmental Impact Statement and proposing to use efficient, relatively precise technology (*Nautilus Minerals Online* 2006). The PNG Government is trying to end the corruption in its own ranks while trying to carry out environmental and other social responsibilities (“Corporate Profile” 2008). Indigenous people are trying to make sure that their interests are represented in the face of major political and economic forces (“Deep-sea Mining Proposals” 2007, “Indigenous Communities” 2008). Events will continue to unfold.

One such event in which interested parties can voice their opinions is the Mining Warden’s Hearing scheduled for 2 April 2009 (*Nautilus Minerals Online* 2006). The people of Papua New Guinea and the southwest Pacific are in a unique position to be proactive, not reactive, about how vent mineral resources will be exploited and they should take full advantage of venues such as the Warden’s Hearing to present their interests. By doing so, they can avoid risking the treasure of the vents themselves for the sake of the resource treasure.

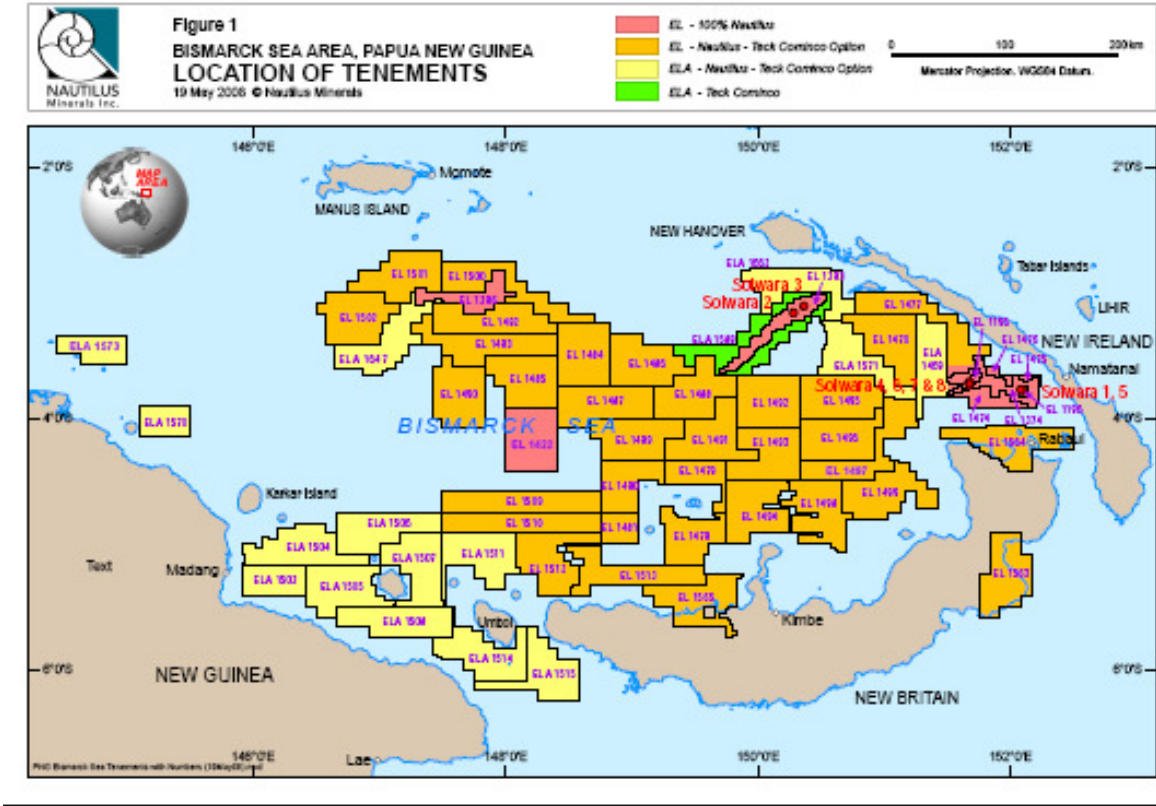


Figure 1.

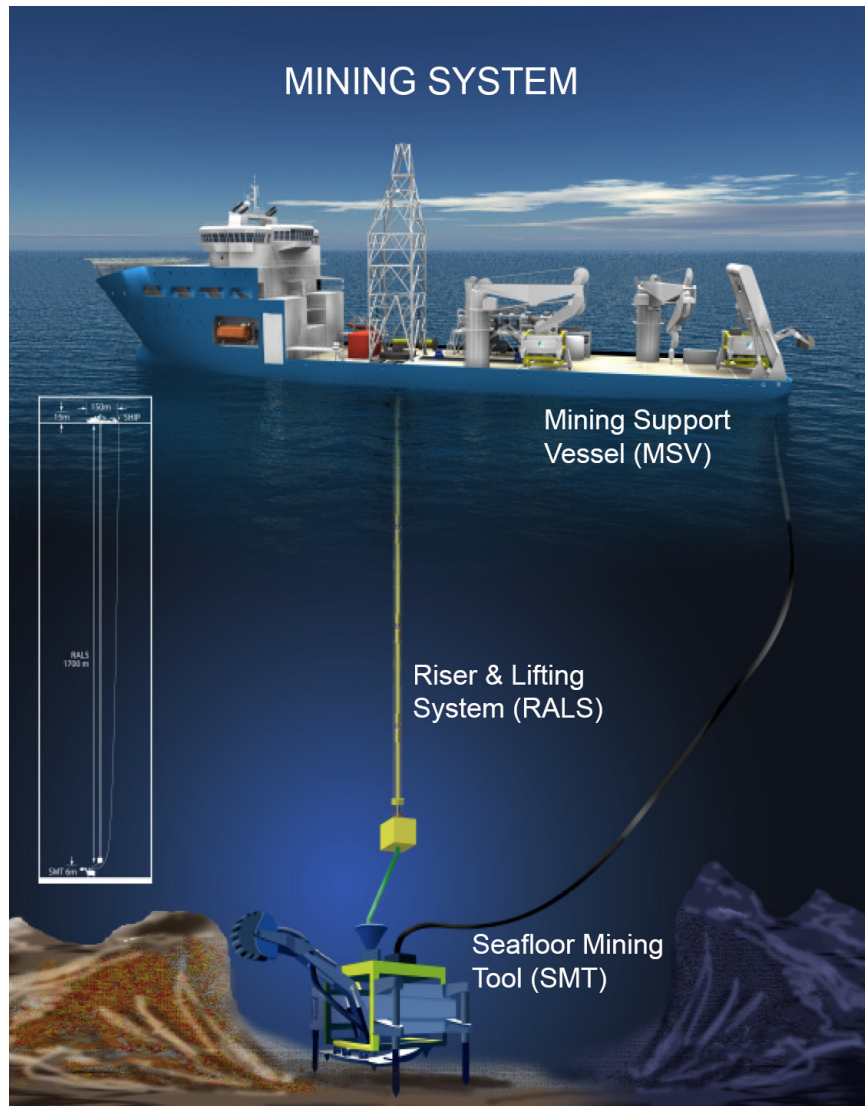


Figure 2.

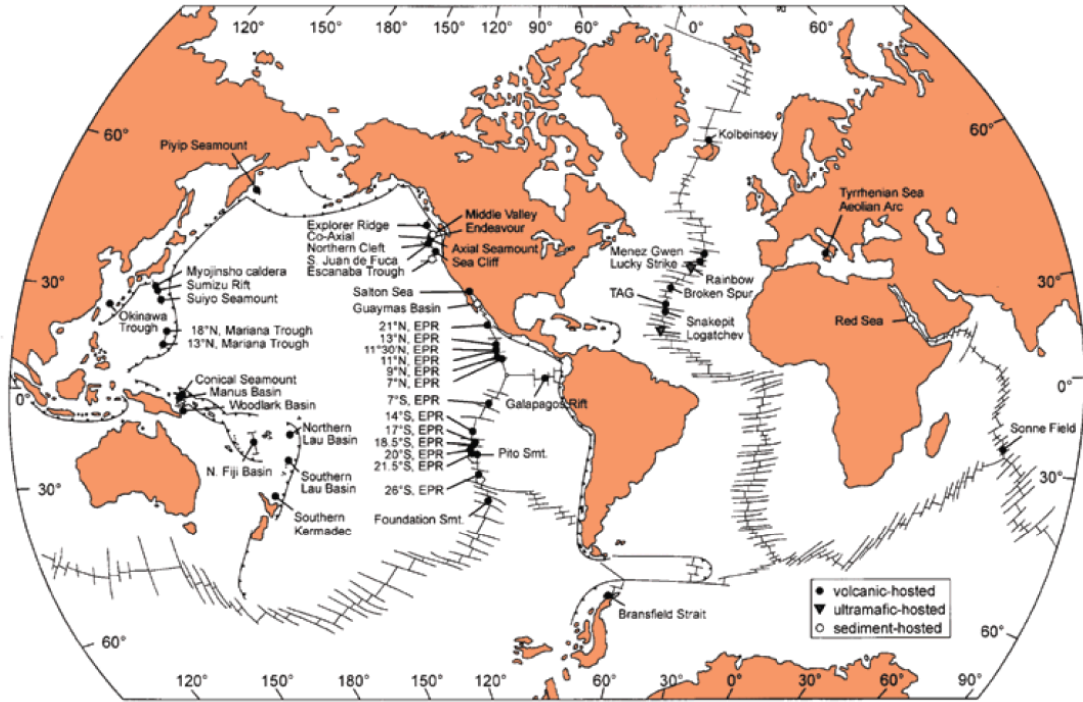


Figure 3.



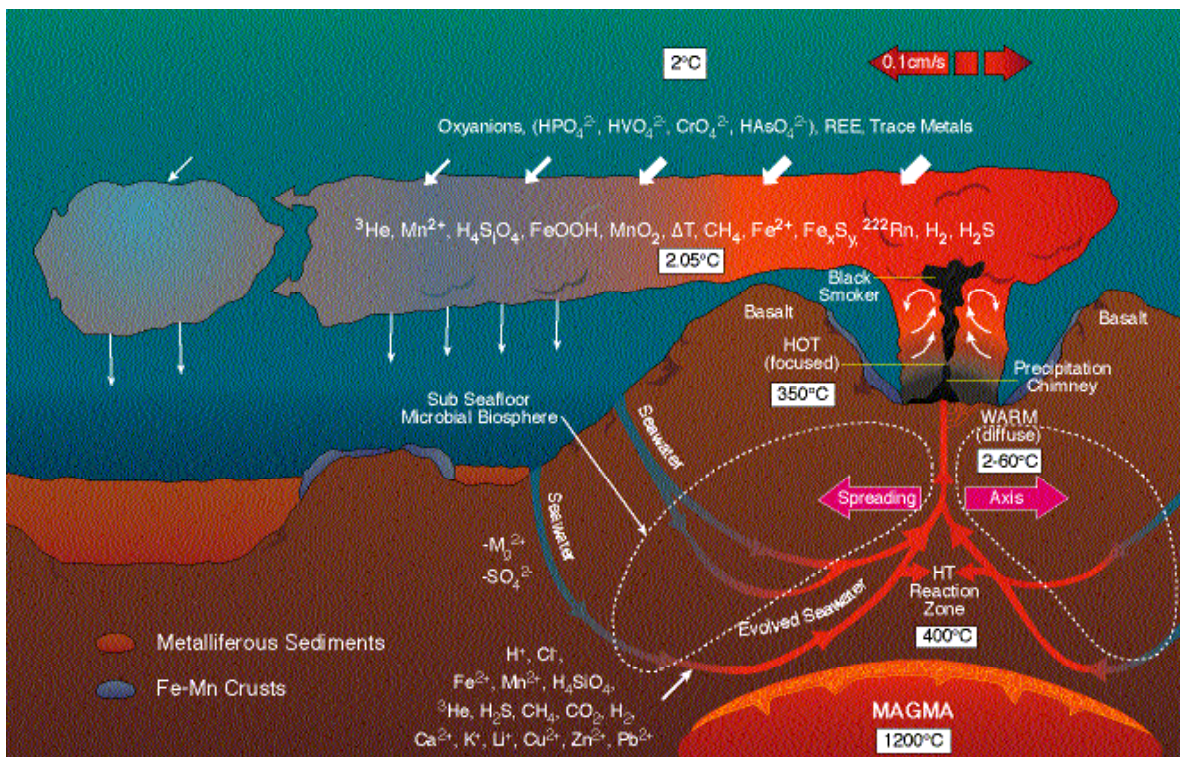


Figure 4.

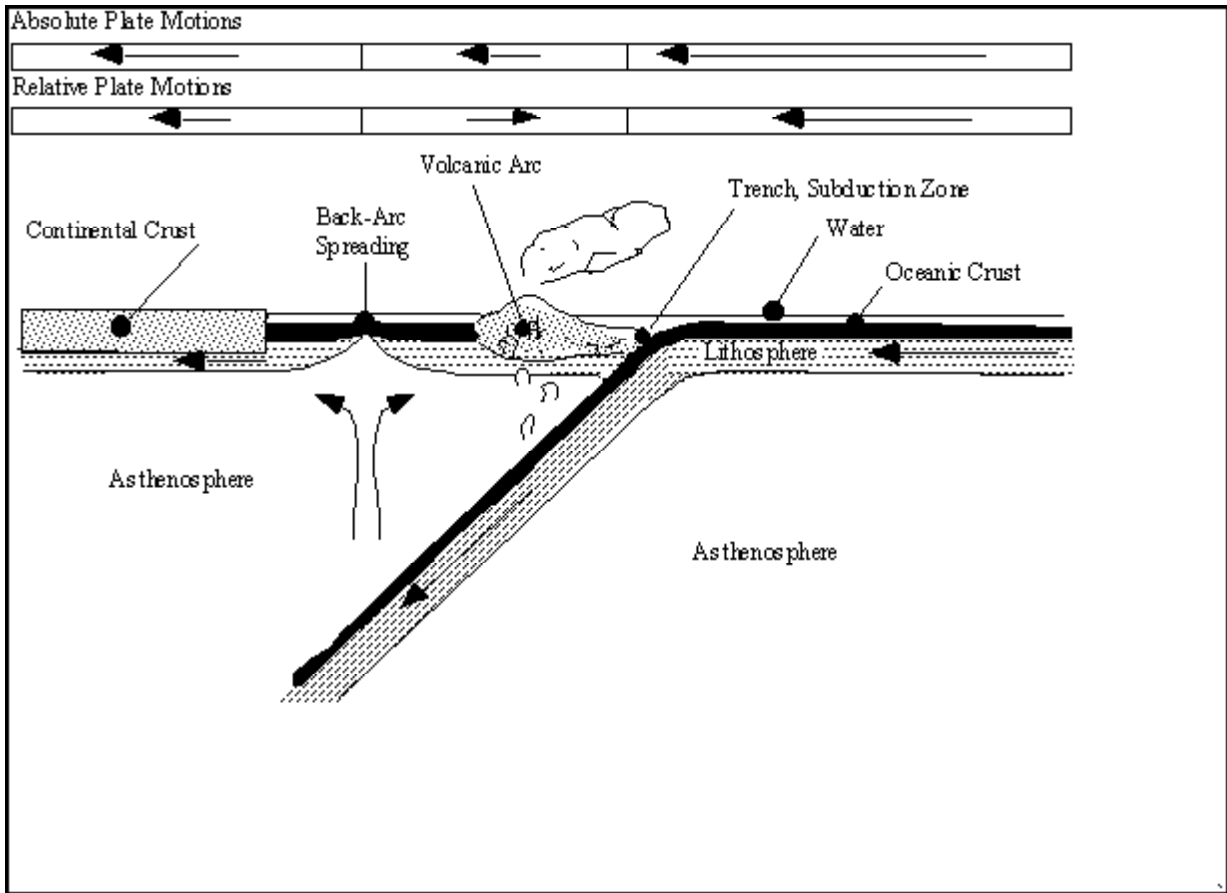
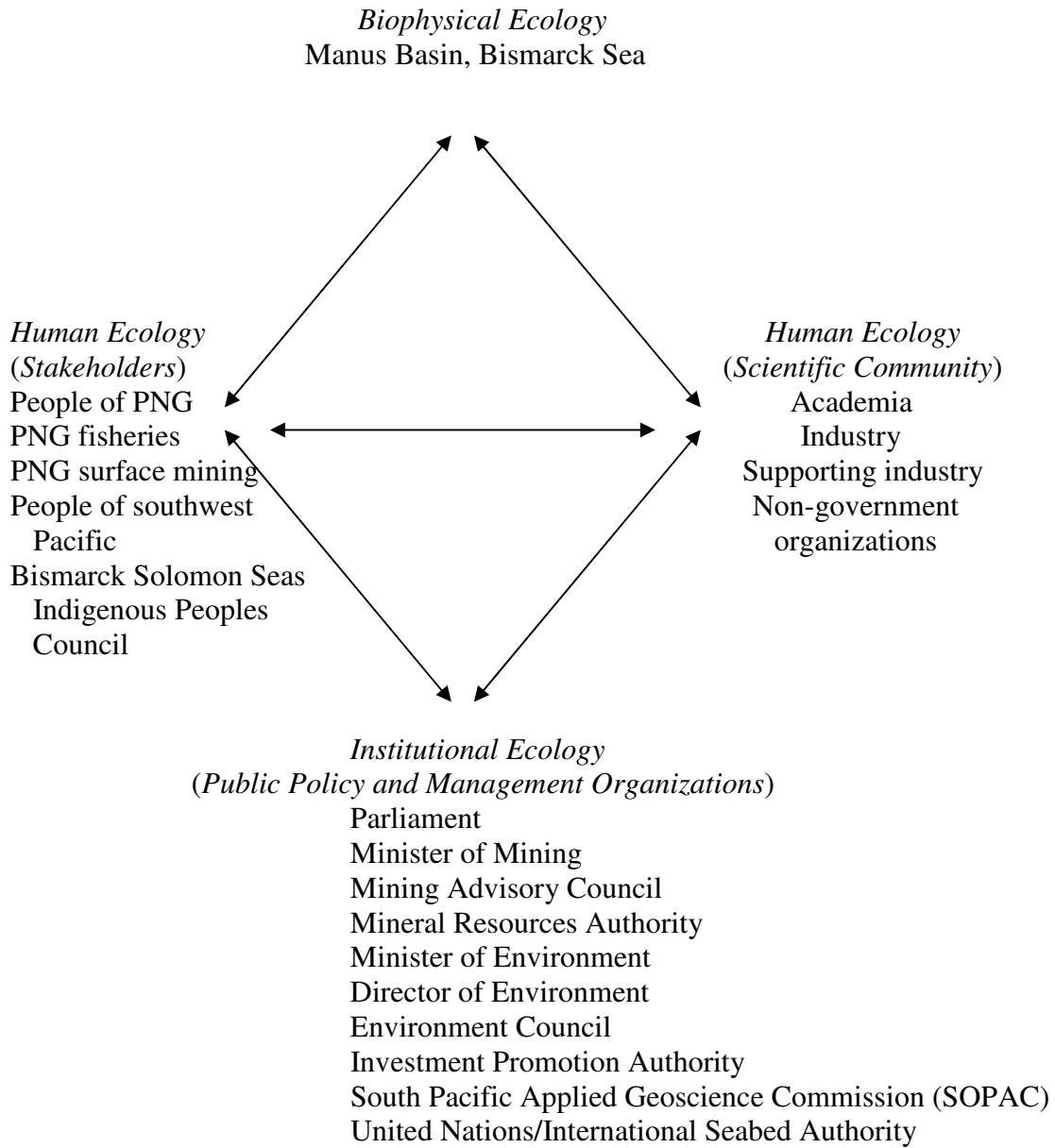
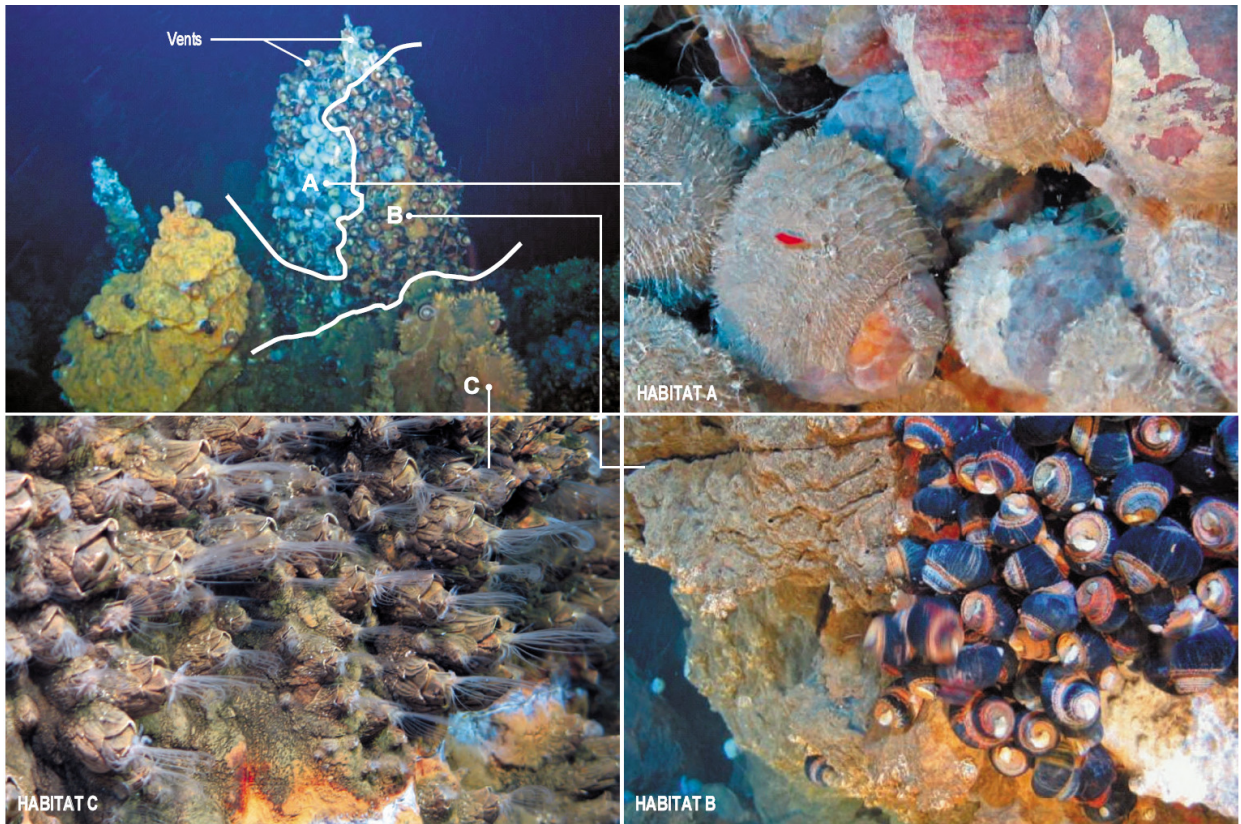


Figure 5.



**Figure 6.**



**Figure 7.**

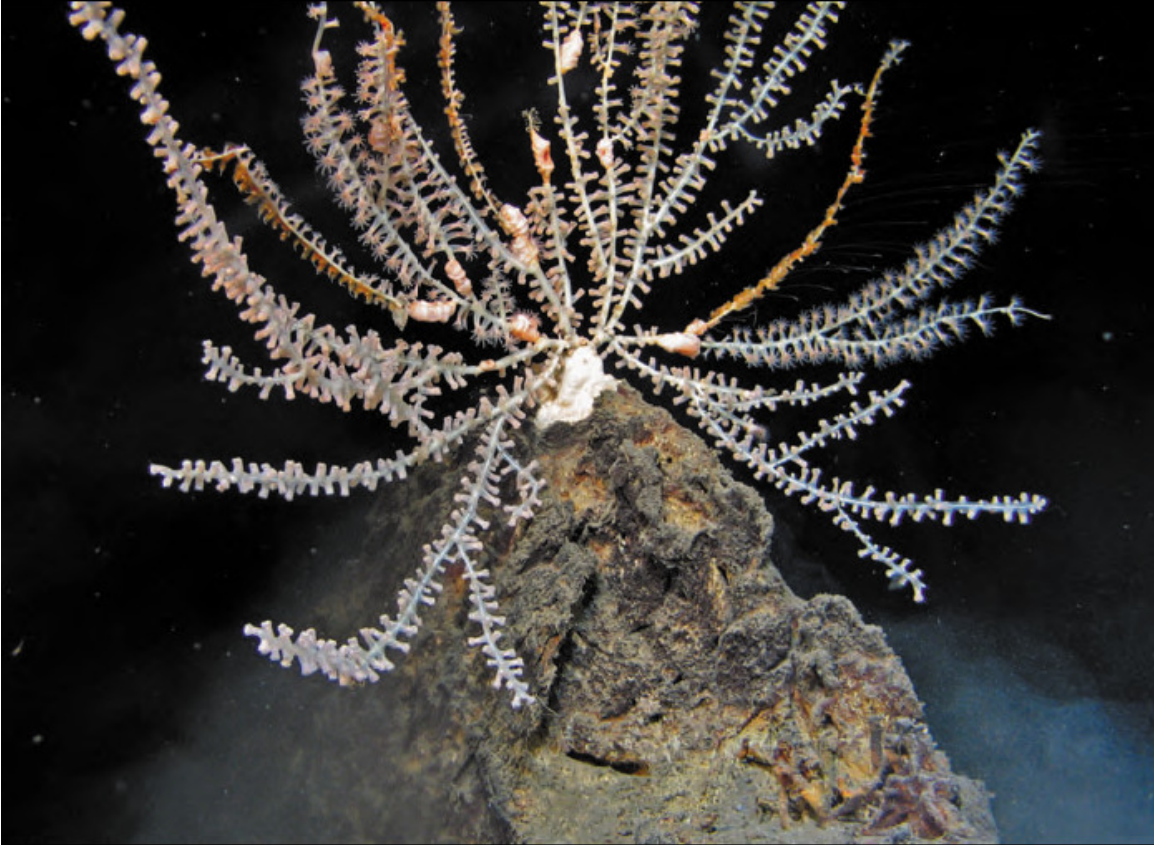




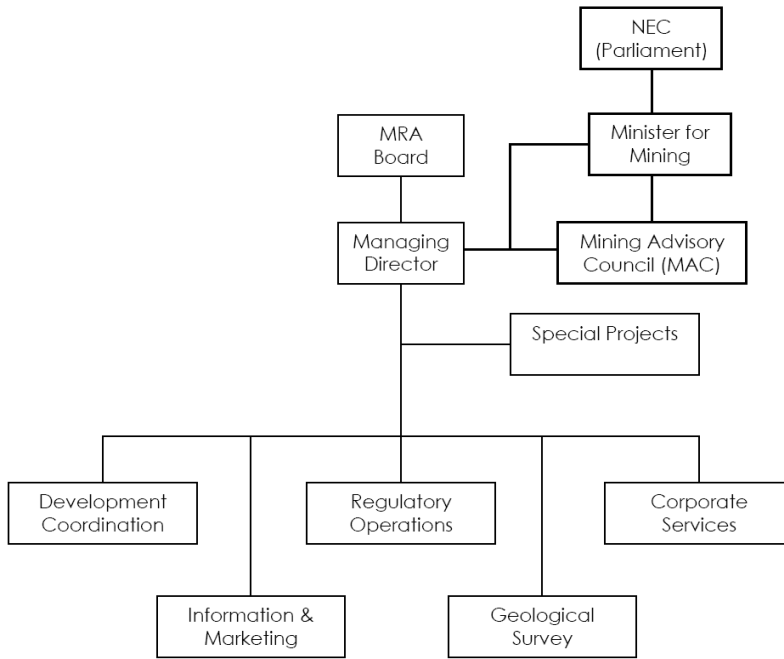
**Figure 8.**



**Figure 9.**



**Figure 10.**



**Figure 11.**



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