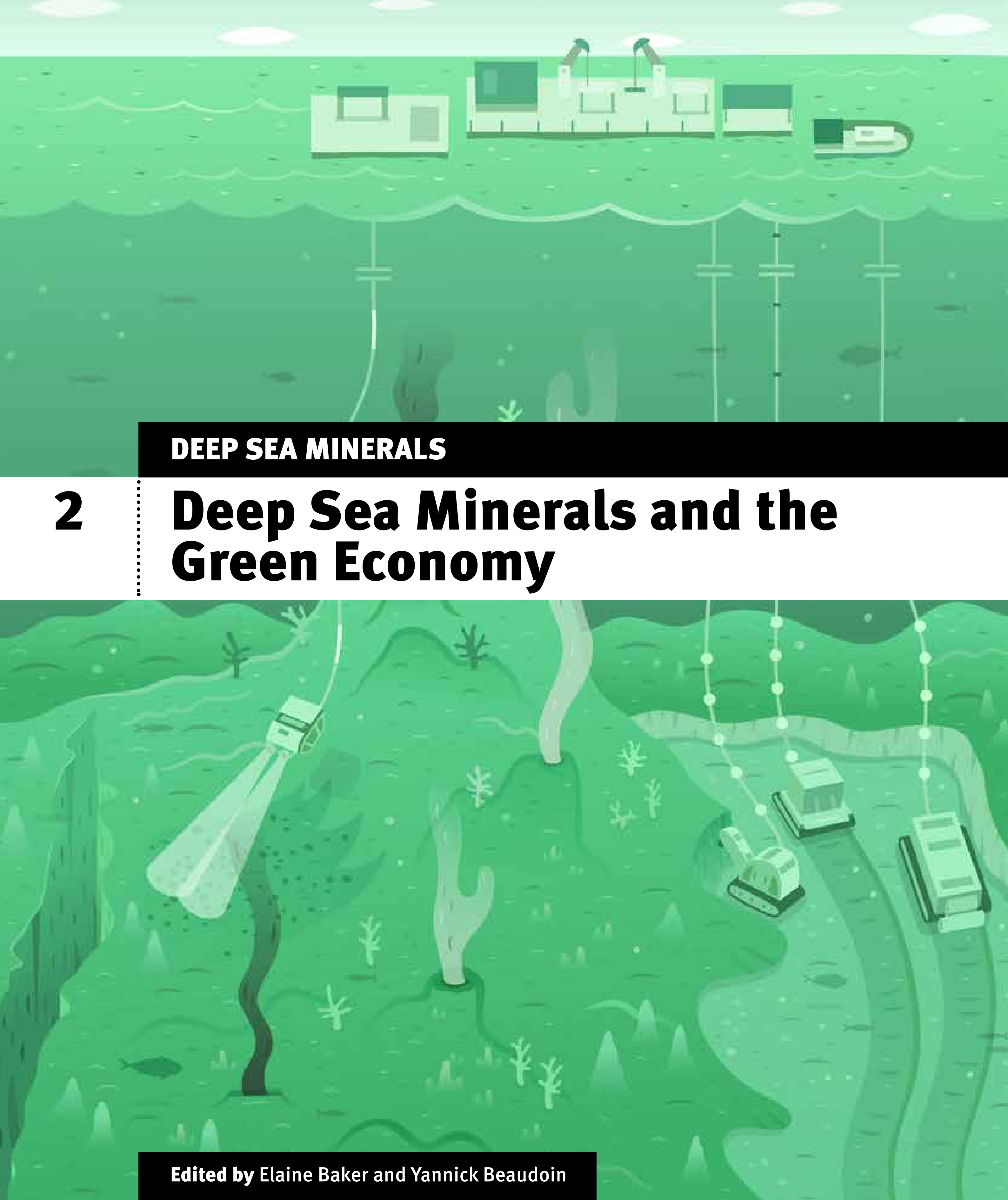

DEEP SEA MINERALS

2 Deep Sea Minerals and the Green Economy

Edited by Elaine Baker and Yannick Beaudoin

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DEEP SEA MINERALS

2 Deep Sea Minerals and the Green Economy

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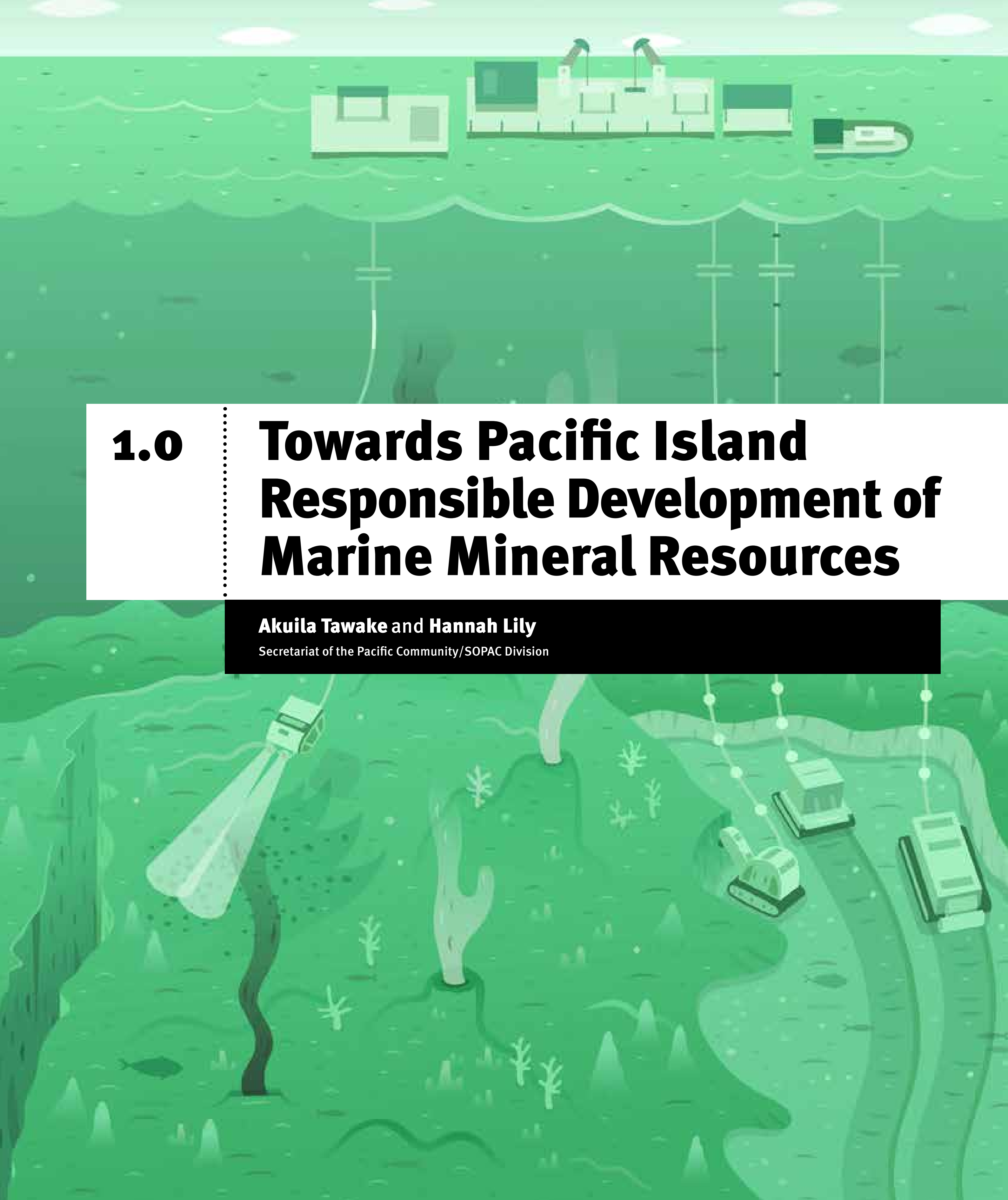


1.0 Towards Pacific Island Responsible Development of Marine Mineral Resources

Akuila Tawake and **Hannah Lily**
Secretariat of the Pacific Community/SOPAC Division

Recognizing the economic potential of marine minerals, exploration companies have been conducting sea floor mapping and sampling programs across the Pacific region in recent years. Seafloor massive sulphide deposits – containing localized concentrations of copper, lead, and zinc, with significant amounts of gold and silver – have been discovered within the national jurisdictions of several Pacific Island states. Manganese nodules and crusts containing notable concentrations of nickel and cobalt, sometimes coupled with significant concentrations of rare-earth elements, have also been identified within the Pacific region. In 2011, Papua New Guinea became the first country to issue a mining licence within its territorial waters.

Notwithstanding this upsurge in interest and activity, most Pacific Island states lack policies, legislation, and regulations for the governance of deep sea mineral resources (SPC 2012). They also lack the technical and human resources needed to manage these resources effectively. In addition, there are legitimate concerns regarding the current state of knowledge about the ecosystems associated with seabed mineral deposits, as well as the economic and social consequences of mineral development. There are environmental and socio-economic challenges throughout the mining cycle, from exploration to extraction and processing, including fiscal management.

1.1 The SPC-EU Deep Sea Minerals Project

A regional approach to policy development, spearheaded by the Applied Geoscience and Technology (SOPAC) Division of the Secretariat of the Pacific Community (SPC), was conceived in response to an increasing number of requests for assistance directed to the Secretariat of the Pacific Community, the Pacific Islands Forum Secretariat, the Commonwealth Secretariat, and the World Bank. This regional approach was based on the commonality of problems faced by Pacific Island states, such as similarities in legal frameworks, small populations and administrations, an interest in harmonizing policies and fiscal regimes, the rapidly developing nature of marine mining technology, approaches to Pacific Island governments by the private sector, and the potential for optimizing shared benefits of development activities. A concept note elaborating this regional approach was presented to Pacific Island state representatives in late 2008. Subsequently, a project proposal developed and submitted to the European Union (EU) was endorsed and given financial support under the 10th European Development Fund.

The SPC-EU Deep Sea Minerals in the Pacific Islands Region: A Legal and Fiscal Framework for Sustainable Resource Management Project (the DSM Project) is being implemented by the SOPAC Division of the SPC over a four-year period (2011-2014). The overall objective of the project is to strengthen governance of the region's deep sea minerals, particularly through the development and implementation within Pacific Island states of:

- sound and regionally integrated legal frameworks and fiscal regimes;
- improved human and technical capacity; and
- effective data management and environmental management and monitoring systems.

The project aims to assist Pacific Island states to engage in a viable and sustainable way with the marine minerals industry, while operating within the physical limits of sensitive island ecosystems and ensuring an equitable distribution of wealth and benefits.

This publication is part of the DSM Project's effort to provide relevant information to stakeholders on the state of knowledge about marine minerals in the Pacific Islands region. It represents the first in-depth integrated review, including socio-economic aspects, of marine mineral exploration and exploitation.

Figure 1.1 The Pacific Island states participating in the SOPAC/SPC Deep Sea Minerals Project.

1.2 A brief history of marine mineral exploration

On the sea floor, there are three main classes of deep sea minerals of economic interest: sea-floor massive sulphides, manganese nodules, and ferromanganese cobalt-rich crusts (see Volumes 1A, 1B, and 1C of this series).

Hydrothermal vents were first discovered at the Galapagos Rift in 1977 (Corliss 1971; Francheteau *et al* 1979). Soon afterward, the manned submersible Alvin, operating on the 21°N East Pacific Rise, discovered more hydrothermal vents and recorded the active formation of massive sulphide deposits. Recognition that these deposits were essentially younger versions of the volcanogenic massive sulphide deposits found on land, which are a major source of copper, zinc, gold, and silver, helped promote further exploration. Currently, there are 245 confirmed active sites of sea-floor massive sulphide accumulation (Beaulieu 2010), although most of these deposits are small. Hannington *et al* (2011) estimate that there are 6 x 10^8 tonnes of sulphide, containing approximately 3 x 107 tonnes of copper and zinc, in the neovolcanic zones of the ocean. This is more than the annual production of these metals from all land-based mines.

Manganese nodules (also referred to as polymetallic nodules) were first discovered lying on the deep-ocean floor during the HMS *Challenger* expedition (1872-1876) and have since been found throughout the world's oceans. It was not until the 1960s, however, that they were considered anything more than a scientific curiosity (Mero 1962; Arrhenius 1963). In 1962, an American oceanographer, J. L. Mero, described manganese nodules in the Pacific Ocean as an essentially limitless resource capable of providing an almost inexhaustible supply of metals, such as manganese, copper, nickel, and cobalt. Coupled with inaccurate predictions of impending global shortages of strategic minerals on land and against a prevailing background of pioneering optimism, Mero's estimates sparked considerable interest at that time from developed nations, such as Germany, Japan, France, and the United States.

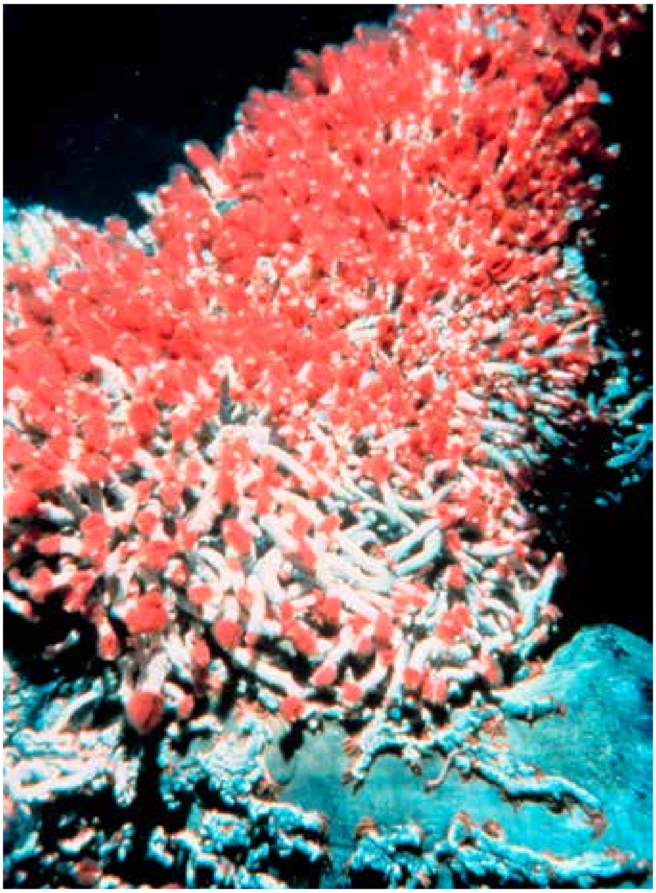
Major technological advances occurred on the back of this early interest in manganese nodules (Glasby 2002). The late 1970s saw the development of an experimental system to recover nodules, which included a self-propelled collection vehicle

Pacific Ring of Fire Expedition. Active smoker chimneys precipitate iron, copper, and zinc sulphides from 230°C fluid. The smoker chimneys seen in the photograph are 9 metres tall from the base to the top. Dark beehive-type chimneys, here about 30 centimetres tall, commonly sit on top of these structures. Photo courtesy of Dr. Bob Embley, NOAA PMEL.

and associated technical innovations, such as automated hydraulic handling and deployment systems (Welling 1985).

The intense interest in manganese nodules in the 1970s was followed by a number of investigations to evaluate the potential of ferromanganese crusts as a source of cobalt. These crusts are found on the slopes of seamounts and undersea ridges around the globe. Studies of these potential resources were carried out across the Pacific (Cronan *et al* 1991b, a; Halbach 1991; Hein *et al* 1992; Cronan and Hodkinson 1993). However, the difficulty in recovering the thin layers of high-grade material from the steep slopes of seamounts was recognized early on, and technological solutions have still not been developed.

From an exciting start, where great things might have been expected from deep sea minerals, progress over the intervening few decades has been slow and unsteady. However, interest in deep sea minerals appears to be renewed – world-first grants of seabed mining licences and a proliferation of exploration activities across the Pacific Ocean appear to show an industry ready to move forward. If this happens, Pacific Island states – as the owners of some of the world's most promising and abundant marine mineral resources – will be at the forefront of the new industry. They will be writing the history of deep sea mineral extraction, and they have the opportunity now to prepare and to make careful and sensible social, fiscal, and environmental decisions.



Tube worms feed at the base of a black smoker chimney hydrothermal vent. Photo courtesy of OAR/National Undersea Research Program (NURP).

Sea-floor massive sulphide. Photo courtesy of S. Petersen, GEOMAR.

A grab sampler collects manganese nodules in the Clarion-Clipperton Zone. Photo courtesy of M.Wiedicke-Hombach BGR.

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2.0 Legal Rights to Deep Sea Minerals

Michael Lodge[1], **Hannah Lily**[2], and **Philip Symonds**[3]

1 International Seabed Authority
2 Secretariat of the Pacific Community/SOPAC Division
3 University of Wollongong

2.1 A constitution for the ocean

During the 1960s, the question of how to manage the resources of the sea preoccupied the United Nations. The prospect that the seabed contained abundant mineral resources led Dr Arvid Pardo, the Permanent Representative of Malta to the United Nations, to make a seminal speech to the General Assembly in November 1967. He referred to the danger of competition for seabed resources and of militarization of the seabed beyond national jurisdiction, and he proposed the establishment of an international regime to govern and manage the seabed and its resources for peaceful purposes.

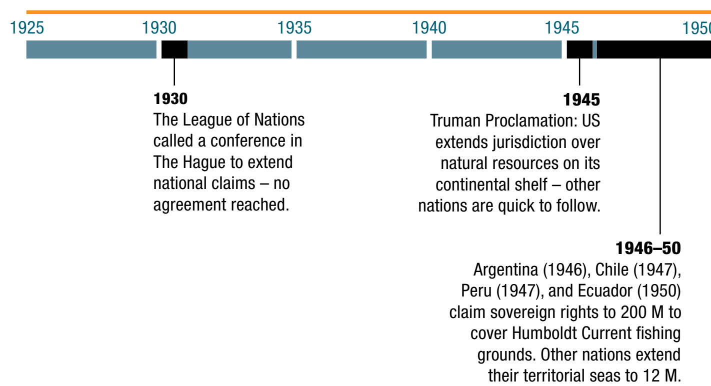
Discussions in the United Nations following Pardo's speech led ultimately to the 1982 United Nations Convention on the Law of the Sea (UNCLOS 1982), providing a legal regime for the deep seabed.

UNCLOS is a "constitution for the oceans" that ranks second only to the Charter of the United Nations as the most significant achievement of the United Nations. (For details, see http://www.un.org/Depts/los/index.htm.)

UNCLOS establishes maritime zones within national control and beyond. Where minerals are located within national jurisdiction, rights and responsibilities are given to the coastal state by UNCLOS. Part XI of UNCLOS created a ground-breaking legal regime for the seabed beyond national jurisdiction, declaring its resources the common heritage of mankind to be reserved exclusively for peaceful purposes and not subject to appropriation by any state. Instead, UNCLOS requires that activities in the international seabed area are to be carried out for the benefit of all and in accordance with rules and procedures established by UNCLOS. The concepts of the "exclusive economic zone" (see section 2.2, below) and the common heritage of mankind as applied to the international seabed area are generally seen as the most far-reaching aspects of the Convention (Levy 2000).

UNCLOS is the most important source of international law pertaining to seabed minerals. It also covers other diverse and related issues, such as access to the seas, navigation, protection and preservation of the marine environment, exploitation and conservation of living resources, and scientific research. UNCLOS was opened for signature at Montego Bay, Jamaica, on 10 December 1982 and entered into force on 16 November 1994. By the middle of 2013, there were 166 parties to the Convention (165 states and the European Union).

UNCLOS provides for the establishment of successive national jurisdictional zones that extend over the continental margin and ocean basins adjacent to maritime nations, as well as international zones that extend beyond national jurisdiction. Since the First (1958) and Second (1960) Conferences on the Law of the Sea had failed to reach agreement on explicit limits to the territorial sea and the extent of the continental shelf, UNCLOS brought welcome clarity and conferred great benefits on coastal states.



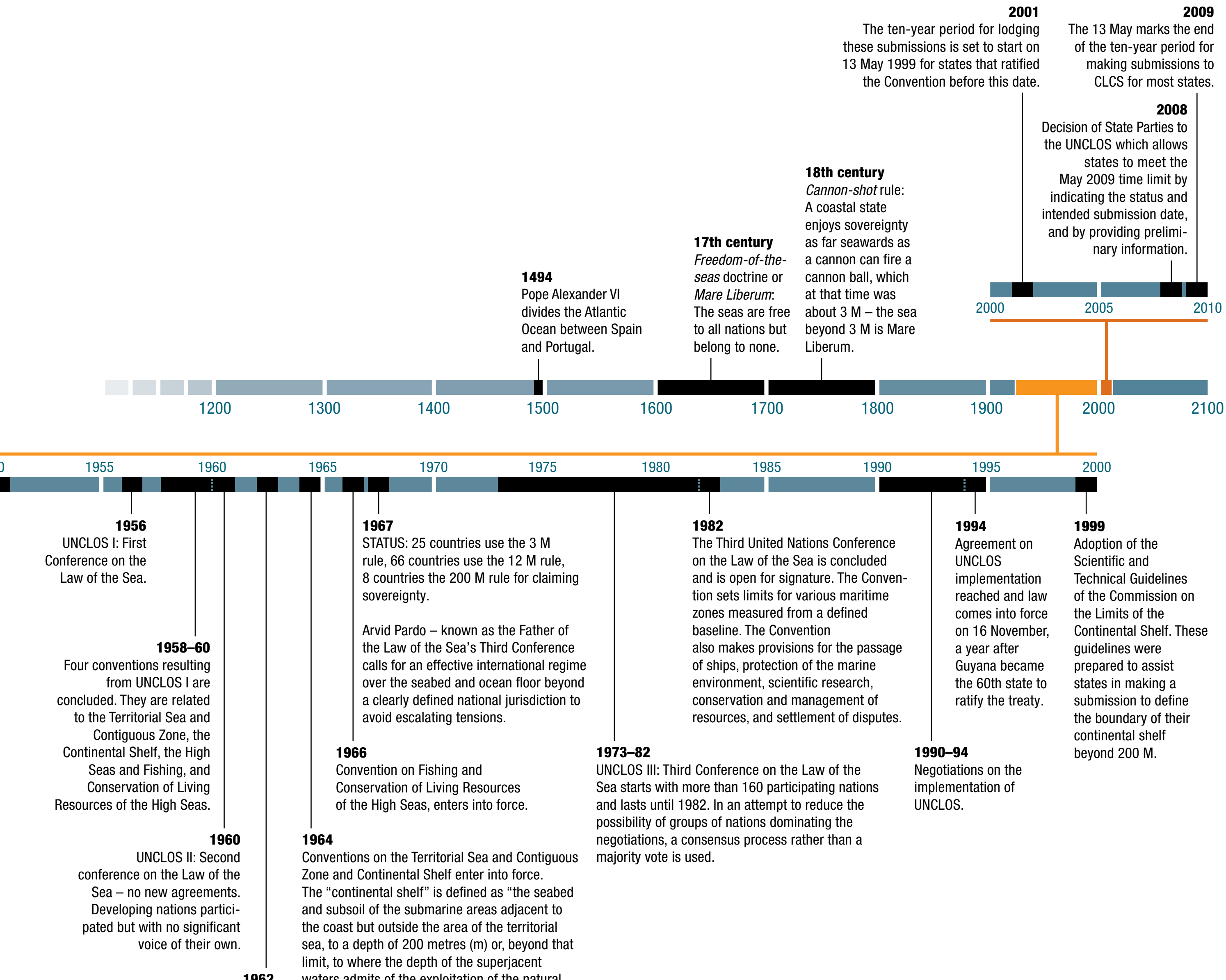


Figure 2.1 History of UNCLOS *(after Schoolmeester and Baker 2009)*

2.2 Marine areas of national jurisdiction

The sovereign territory of a coastal state extends only to the limits of its territorial sea – 12 nautical miles from the coastline. Beyond that, the UNCLOS maritime zones are associated with various exclusive and non-exclusive sovereign rights and duties outlined below, and no sovereign territory is involved (Figure 2.2). Under UNCLOS, all member states have the obligation to protect and preserve the marine environment. In particular, coastal states' sovereign rights to exploit resources in their national jurisdictions must be exercised in a manner consistent with their duty to protect and preserve the marine environment.

The characteristics and rights associated with the UNCLOS maritime zones that delineate national jurisdiction (summarized in Figure 2.2) are as follows:

- Territorial Sea: Extends not more than 12 nautical miles from the territorial sea baseline. A coastal state has sovereignty over this zone, just as it has sovereignty over its land territory and any inland waters, or internal waters that occur between islands in an archipelagic country. This zone includes the water column, seabed, and subsoil, as well as the airspace above it.
- Contiguous Zone: The 12 nautical miles beyond the territorial sea (running from 12 nautical miles to 24 nautical miles from the baseline), in which a coastal state may exercise control over customs, immigration, and quarantine matters.
- Exclusive Economic Zone (EEZ): The EEZ is measured from the territorial sea outwards, for up to 200 nautical miles from the territorial sea baseline. Where there is a neighbouring country, and there would be an overlap if both EEZs were measured out to the full 200 nautical miles, the two countries negotiate and agree on the position of the boundary. This boundary is normally confirmed by a treaty between the states. Within its EEZ, a coastal state has exclusive sovereign rights for the purposes of exploring and exploiting, conserving, and managing the natural resources (living or non-living) of the water column, seabed, and subsoil. This jurisdiction also extends to the establishment and use of artificial islands, installations and structures, marine scientific research, and the protection and preservation of the marine environment. In exercising its rights and performing its duties in the EEZ, a coastal state is obliged to respect the rights and duties of other states and to exercise its EEZ rights with respect to the seabed and subsoil in accordance with Part VI of UNCLOS, which relates to the continental shelf.
- Continental Shelf: The continental shelf (as defined by UNCLOS) is the sea floor that extends beyond the territorial sea up to 200 nautical miles from the territorial sea baseline or beyond that to the outer edge of the continental margin, as defined in article 76 of UNCLOS.

Continental shelf beyond 200 nautical miles

In cases where the continental shelf extends beyond 200 nautical miles, coastal states are required to submit information on the outer limits of their continental shelf beyond 200 nautical miles, delineated in accordance with requirements specified in UNCLOS, to the Commission on the Limits of the Continental Shelf (the Commission or CLCS). The Commission, an expert institutional body established under UNCLOS and based in New York, considers these submissions and makes recommendations to coastal states on matters related to the establishment of the outer limits of their continental shelf. The limits of the continental shelf established by a coastal state on the basis of the recommendations adopted by the Commission are final and binding.

By mid-2013, the Commission had received 67 submissions for continental shelf beyond 200 nautical miles, involving 55 states. Eight of these submissions, involving nine Pacific Island states, are for the southwest Pacific.

Article 82 of UNCLOS contains a particular provision with respect to the exploitation of any non-living resources (such as minerals) from the continental shelf beyond the 200 nautical miles. The coastal state is required to make payments or contributions in kind to the body established to manage the international seabed – the International Seabed Authority (see Text Box).

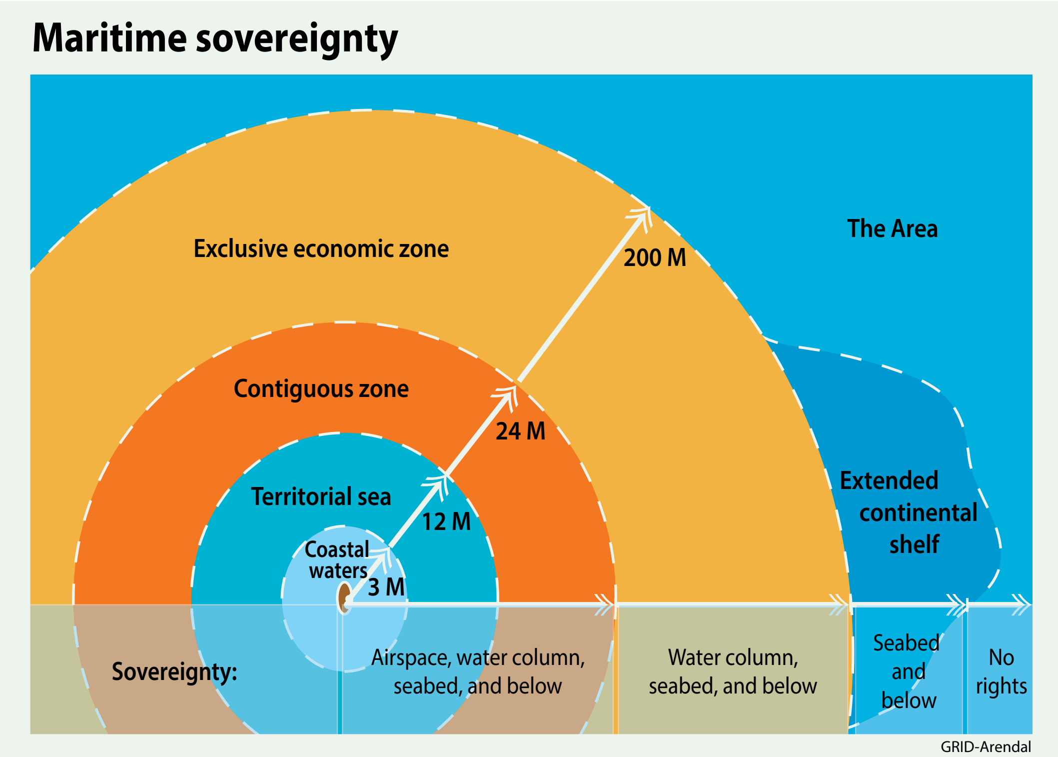


Figure 2.2 Maritime zones and rights under the 1982 United Nations Convention on the Law of the Sea (UNCLOS). M = nautical miles.

Within its continental shelf, a coastal state has sovereign rights for the purposes of exploring and exploiting mineral and other non-living resources of the seabed and subsoil, together with sedentary living organisms. These rights are exclusive in the sense that if the coastal state does not explore its continental shelf or exploit its natural resources, no one may undertake these activities without its express consent. The rights of a coastal state over its continental shelf are inherent and do not depend on occupation, effective or notional, or on any express proclamation. Within its continental shelf, a coastal state also has jurisdiction with regard to:

- the establishment and use of artificial islands, installations, and structures;
- drilling of the continental shelf;

Payments and contributions with respect to exploitation of non-living resources of the continental shelf beyond 200 nautical miles

A coastal state is required by Article 82 of UNCLOS to make payments or contributions in-kind through the International Seabed Authority for exploitation of the non-living resources of the continental shelf beyond 200 nautical miles. Payments and contributions are to be made annually at the rate of one per cent on the value or volume of all production, commencing in the 6th year of production and increasing by one per cent per year until the rate reaches seven per cent in the 12th year. Thereafter, it remains at seven per cent. The International Seabed Authority distributes the payments and contributions to participating states according to equitable sharing criteria, taking into account the interests and needs of developing states and, in particular, the least developed and land-locked states.

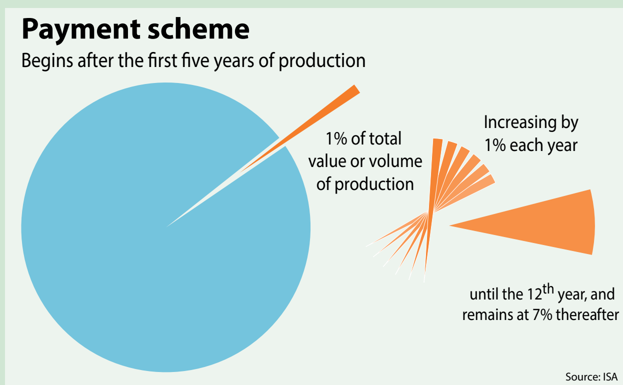


Figure 2.3 Payment scheme.

- cables and pipelines constructed or used in connection with exploration of the continental shelf and exploitation of its natural resources or to the operations of artificial islands, installations, and structures;
- marine scientific research; and
- the prevention, reduction, and control of pollution of the marine environment arising from or in connection with seabed activities.

In the Pacific region, potential deep sea mining activities will largely lie within the national jurisdiction associated with the 200-nautical-mile and extended continental shelves of the Pacific Island states (Figure 2.4). For this reason it is important for each state to delineate and legally declare its maritime boundaries. Unless the boundaries are certain, the state (and investors) cannot know which mineral deposits lie within the country's jurisdiction and which lie outside it, within a neighbouring country's waters or international waters.

In addition to the rights to develop seabed minerals, which are conferred on coastal states by UNCLOS and which are outlined above, there are also international legal obligations that states must meet, particularly in relation to the protection of the marine environment. To discharge these responsibilities, states must have national laws in place that set the standards required by international law, and those standards must be imposed, monitored, and enforced in relation to any seabed mineral activities the country permits within its national waters. Further detail on these matters can be found in Chapter 6 of this volume.

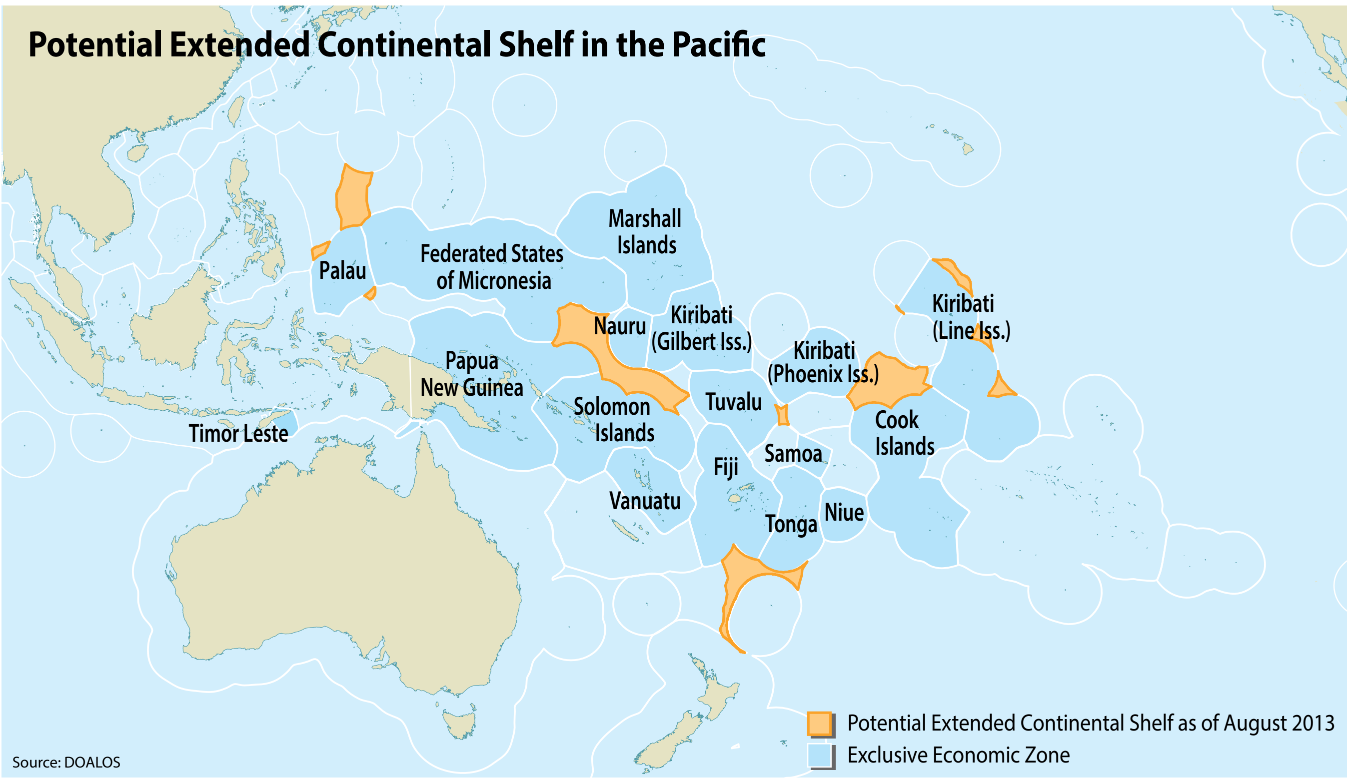


Figure 2.4 Maritime jurisdiction and extended continental shelf submissions of Pacific Island states.

2.3 Marine areas beyond national jurisdiction

Section 2.2, above, details the zones and attached rights within national jurisdiction. The remainder of this chapter examines the regime for the seas that lie beyond these boundaries: areas beyond the limits of national jurisdiction. These can be summarized as follows:

- High seas: The water column beyond the EEZ. No single country has control or sovereign rights over the ocean beyond the EEZ national jurisdiction. On the high seas, all states have freedom of navigation and overflight. Subject to other parts of UNCLOS (such as the duty to protect the environment and to have due regard to the similar activities of other persons on the high seas), states also have freedom to lay submarine cables and pipelines, construct artificial islands and other installations, fish, and conduct scientific research.
- The Area: The seabed and subsoil beyond the limits of national jurisdiction (i.e., all of the seabed that lies beyond each country's continental shelf) is known as the Area. The Area and its mineral resources are declared by UNCLOS to be "the common heritage of mankind." The seabed minerals of the Area are managed on behalf of all by the International Seabed Authority (ISA), an institutional body established under UNCLOS. No country may claim or declare sovereign rights or try to appropriate any part of the Area or its resources. But any UNCLOS member country is eligible to undertake seabed mineral activities in the Area, subject to the rules of UNCLOS and the ISA – which state that such activities shall be carried out for the benefit of mankind.

The regime for deep seabed mining in the Area is elaborated in Part XI of UNCLOS and was a controversial subject for many states. It was not until 1994 that UNCLOS, first agreed in 1982, finally entered into force. The catalyst for this development was adoption by the General Assembly of an Agreement for the Implementation of Part XI of UNCLOS, which substantially modified the original provisions of Part XI in order to make them acceptable to the industrialized nations. The 1982 Convention and the 1994 Agreement are to be read and interpreted "as a single instrument."

2.4 International Seabed Authority

The International Seabed Authority (ISA) was established under UNCLOS to organize and control activities in the Area, including seabed mineral activities (defined as prospecting, exploration, and exploitation).

The ISA came into existence on 16 November 1994, on the date of entry into force of the 1982 Convention. It is an autonomous international organization with headquarters in Kingston, Jamaica. All States Parties to the Convention are automatically members of the International Seabed Authority. As of mid-2013, it had 166 members (165 states and the European Union).

Prospecting, exploration, and exploitation (referred to in the Convention as "activities in the Area") may only be carried out under a contract with the International Seabed Authority. Contracts are approved by ISA's executive council, on the recommendation of the Legal and Technical Commission.

Between 2001 and 2013, the International Seabed Authority has approved 19 applications for exploration contracts in the Area. These include contracts for each of the three different mineral types (manganese nodules, sea-floor massive sulphides, and cobalt-rich ferromanganese crusts). Twelve of the exploration sites are in the Clarion-Clipperton Fracture Zone (also referred to as the Clarion-Clipperton Zone (CCZ); a large expanse of seabed underlying international waters of the Pacific Ocean, east of the Line Islands Group of Kiribati, and west of Mexico). The remainder are in the Indian Ocean, the Atlantic Ocean, and the northwestern Pacific Ocean. These contracts allow companies to conduct exploration activities for a period of 15 years, reporting on their programs of activities annually. Each contractor is required to provide a program for the training of nationals of developing states.

Contracts may be awarded to States Parties (signatories of UNCLOS), state enterprises sponsored by States Parties, or to natural or juridical persons having the nationality of States Parties and sponsored by States Parties. This element of sponsorship is fundamental to the international regime, as it is designed to ensure that a State Party to UNCLOS ultimately has international responsibility for the activities of contractors with the International Seabed Authority. As private entities, they are not directly bound by UNCLOS.

Although UNCLOS and the 1994 Agreement contain the underlying legal regime for seabed mining, the detailed rules, regulations, and procedures for these activities are set out in a Mining Code, which is being progressively elaborated by the International Seabed Authority as seabed mining activities develop. The Authority has developed regulations on prospecting and exploration for polymetallic nodules (ISA 2000), sea-floor massive sulphides (ISA 2010b), and cobalt-rich ferromanganese crusts (ISA 2012); Figure 2.6).

UNCLOS recognizes the economic and technological imbalance between developed and developing countries. In line with the Common Heritage of Mankind principle, it aims to promote equitable participation in activities in the Area by developing countries. The International Seabed Authority therefore operates a system of site-banking: when a developed state applies for an exploration licence, it must propose two exploration sites of "equal estimated commercial value." If the application is successful, one of these two sites is allocated to the applicant by the ISA, and the other becomes a reserved site, accessible only to developing states (or by the ISA through its Enterprise, if and when the Enterprise comes into existence).

Developing states can apply for a contract to conduct seabed mineral operations via a sponsored third party (e.g., a privately-owned company registered in the member state holding a certificate of sponsorship from the state). The sponsored company will be responsible for delivering the contract and will have rights to any minerals extracted. The state is likely to agree in advance on an annual payment and/or share of the proceeds in exchange for its sponsorship. Member states that sponsor contract-holders must ensure that all their activities in the Area are effectively controlled by the state and are carried out in conformity with the rules set by the ISA's Mining Code and the requirements of UNCLOS. Nauru and Tonga have followed this model.

Fiji recently became one of the few countries in the world (alongside the United Kingdom and Germany) to put in place national legislation to govern sponsorship arrangements and to hold any future sponsored companies to the requisite legal standards (Government of Fiji 2013).

The International Seabed Authority Governance

The primary policy-making organ of the Authority is the Assembly, comprising all members (that is, all of the countries that have signed UNCLOS, which includes all of the Pacific ACP States). Executive authority is vested in a 36-member council, elected according to a four-year cycle. The council is also the primary legislative organ of the Authority. To ensure a balance of interests, the council is divided into five chambers, representing:

- major consumers of the metals derived from seabed minerals;
- major investors in seabed mining;
- major net exporters of the metals derived from seabed minerals;
- special interests (including small island developing states, states with large populations, and land-locked and geographically disadvantaged states); and
- a chamber elected on the basis of equitable geographic distribution.

The council has two subsidiary bodies made up of experts elected in their personal capacity: a Legal and Technical Commission and an Economic Planning Commission. Under the 1994 Agreement, the functions of the Economic Planning Commission are to be carried out by the Legal and Technical Commission until such time as commercial seabed mining begins. The primary functions of the Legal and Technical Commission are to formulate the rules, regulations, and procedures for prospecting, exploration, and exploitation, to review the performance of contractors with the Authority, and to advise the council on matters related to protection of the marine environment from the harmful impacts of mining.

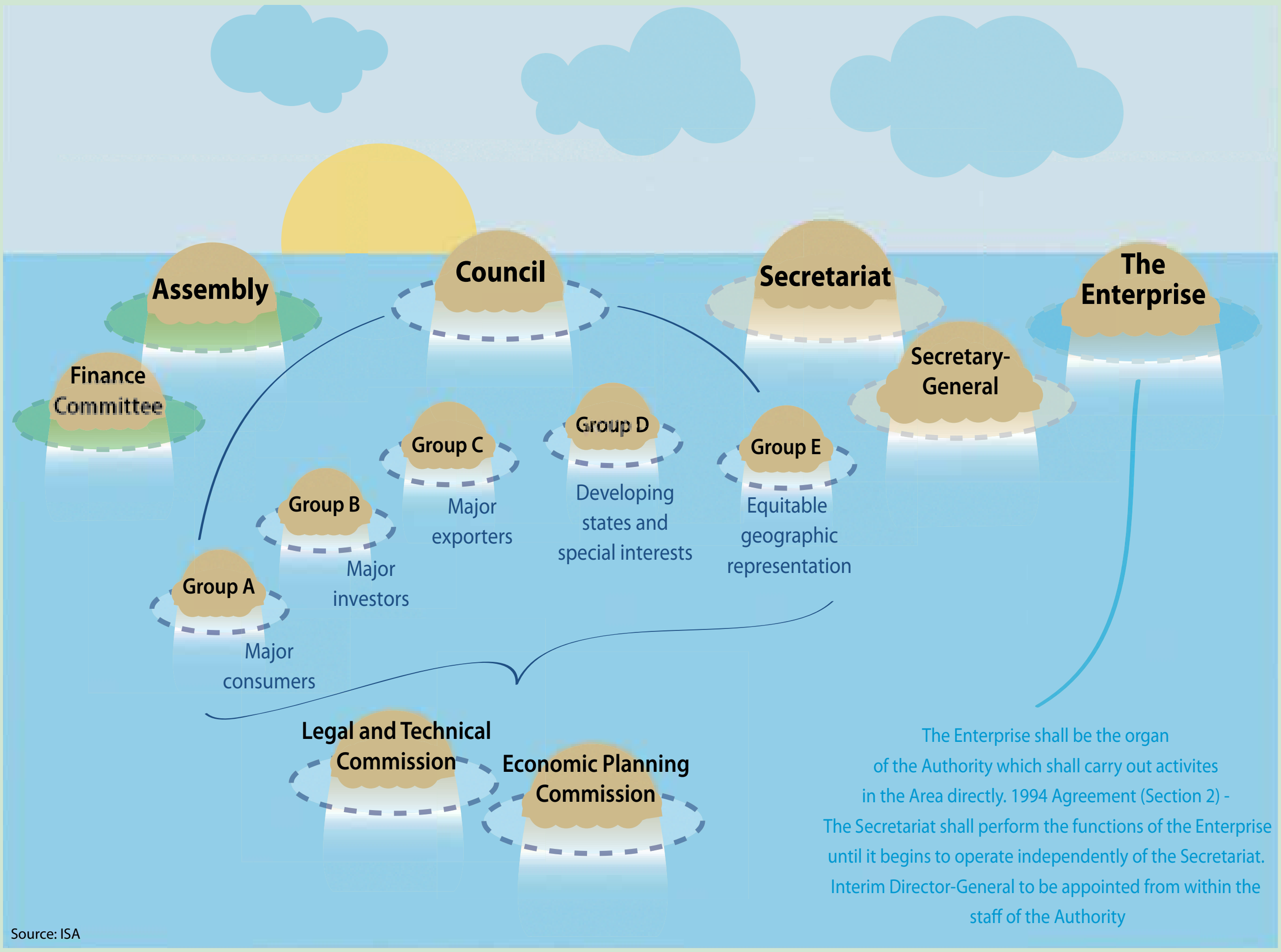


Figure 2.5 The International Seabed Authority governance structure.

One of the features of the regulations is that they contain standard clauses for exploration contracts, which are non-negotiable and apply equally to every contractor with the Authority. The regulations are supplemented by recommendations to guide contractors in the implementation of their contracts with the Authority. These are issued from time to time by the Legal and Technical Commission, as necessary.

While the primary function of the ISA is to regulate seabed mining in the Area, it also has broad responsibilities to take measures for the protection of the marine environment of the Area from the harmful effects of seabed mining (Article 145 of UNCLOS), as well as to conduct, promote, and encourage marine scientific research in the Area for the benefit of developing states (Article 143 of UNCLOS).

The measures taken to date include regulations that require exploration contractors to collect and submit to the Authority environmental data that will help to establish environmental baselines for the conduct of environmental impact assessments.

The International Seabed Authority has also developed an environmental management plan for the seabed of the Clarion-Clipperton Zone, which is the main area of interest for nodule mining.

Mining Code

Regulating prospecting, exploration, and exploitation of marine minerals in the international seabed area

Resource	Prospecting and Exploration	Extraction
Polymetallic nodules 	Regulations for Prospecting and Exploration of Polymetallic Nodules (2000). Supplemented by recommendations from the Legal and Technical Commission for the guidance of contractors on the assessment of environmental impacts of exploration; and guidance on financial reporting.	To be developed
Sea-floor massive sulphides 	Regulations on Prospecting and Exploration for Polymetallic Sulphides (2010)	To be developed
Cobalt-rich ferromanganese crusts 	Regulations on Prospecting and Exploration for Cobalt-Rich Crusts (in prep.)	To be developed

Figure 2.6 Regulations on prospecting, exploration, and extraction developed by the International Seabed Authority.

The establishment of environmental baselines in the Clarion-Clipperton Zone

The Mining Code's regulations on prospecting and exploration within the Area require contractors to gather environmental baseline data. This data, in conjunction with any recommendations from the Legal and Technical Commission of the International Seabed Authority, will be used to establish environmental baselines against which to assess the likely effects of the contractor's program of activities. In addition, the contractor must develop a program to monitor and report such effects.

The International Seabed Authority has issued a set of recommendations for the guidance of contractors, describing the procedures to be followed in the acquisition of baseline data and the monitoring to be performed during and after tests of collecting systems and equipment (Figure 2.7; ISA 2010a).

The environmental baseline in the exploration area incorporates seven groups of data: physical oceanography, chemical oceanography, sediment properties, biological communities, bioturbation, sedimentation, and geological properties. The types of data to be collected, the frequency of collection, and the analytical techniques used must follow the best available methodology and employ an international quality system and certified laboratories.

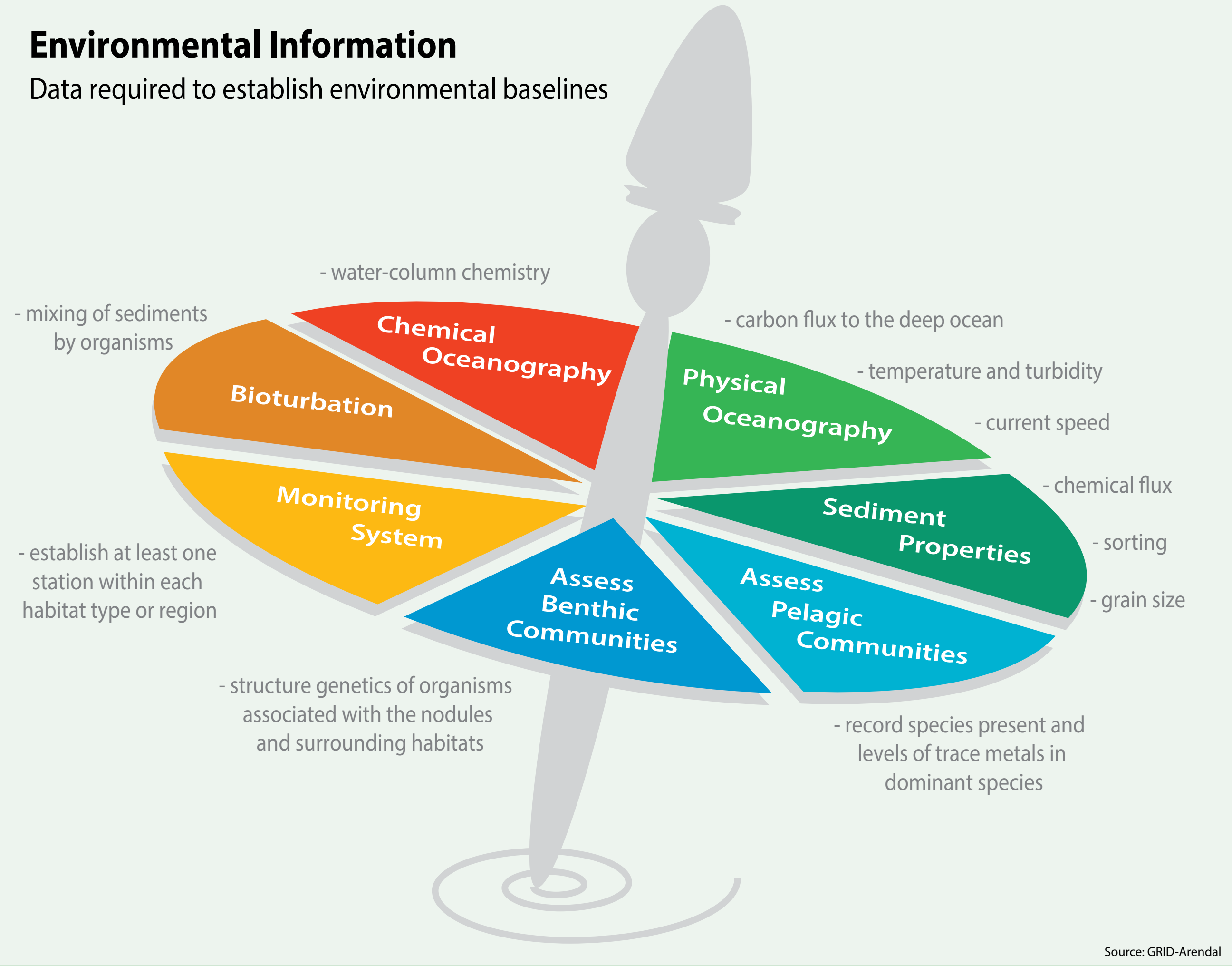


Figure 2.7 Environmental information required by the ISA to establish environmental baselines.

2.5 UNCLOS state duties to protect the marine environment

UNCLOS contains important provisions requiring the protection of the marine environment from seabed activities (Articles 208 and 209). Read together, these two provisions require that the rules, regulations, and procedures to prevent pollution from seabed activities within national jurisdiction should be compatible with those in the Area.

Article 208 requires coastal states to adopt laws and regulations, and to take such other measures as may be necessary, to prevent, reduce, and control pollution of the marine environment arising from, or in connection with, seabed activities subject to their jurisdiction. States must endeavour to harmonize their policies in this connection at the appropriate regional level. Furthermore, such laws, regulations, and measures are required to be no less effective than international rules, standards, and recommended practices and procedures, such as those adopted by the International Seabed Authority.

Article 209 requires international rules, regulations, and procedures to be established (through the ISA) to prevent, reduce, and control pollution of the marine environment from activities in the Area. In addition, states are required to adopt laws and regulations to prevent, reduce, and control pollution of the marine environment from activities in the Area undertaken by vessels flying their flag or of their registry or operating under their authority. The requirements of such laws and regulations shall be no less effective than the international rules, regulations, and procedures adopted by the International Seabed Authority.

Other international agreements add to these requirements. How these duties may be met by states is considered further in Chapter 6 of this volume.

The fiscal regime for deep seabed mining in the Area

UNCLOS designated the mineral resources of the international seabed Area as the "common heritage of mankind." Implicit in this designation is the notion that the benefits of deep seabed mining are to be shared for the benefit of mankind as a whole, irrespective of the geographical location of states. The International Seabed Authority is empowered to establish the financial terms upon which seabed mining may take place, as well as rules and procedures for the equitable sharing of financial and other economic benefits.

UNCLOS contained detailed and prescriptive provisions on the financial terms of deep seabed mining, involving the payment of a production charge based on a percentage of processed metals produced. These provisions proved to be contentious, however, and were removed as part of the 1994 Implementation Agreement. The International Seabed Authority is required instead to develop a fiscal regime on the basis of general principles set out in the 1994 Agreement. These general principles include, among others:

- that the system of payments to the Authority shall be fair to both the contractor and the Authority and shall provide adequate means of determining compliance;
- that the rate of payments shall be within the range of those prevailing in respect of land-based mining;
- that the system should not be complicated; and
- that an annual fixed fee should be payable.

The International Seabed Authority commenced work on the fiscal regime in 2011 with a view to putting a system in place by 2015.

Flange community. Photo courtesy Chuck Fisher.

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3.0 Drivers for the Development of Deep Sea Minerals in the Pacific

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Could the world's hunger for metals and minerals, and state strategies for securing access to them, propel the development of deep sea mining?

Identifying the drivers of a Pacific deep sea minerals industry requires a global perspective on metals demand, an understanding of the forces influencing the mining and minerals industry, and a regional perspective on need and opportunity in the Pacific. The combined picture is complex, with high levels of uncertainty, due to the dynamic and often interrelated nature of the drivers.

Long-term decreasing metal industry productivity, falling ore grades, and increased costs, combined with increased environmental, social, and cultural expectations for sustainability, create an opportunity for deep sea minerals as an alternate source of metal supply (along with reuse and recycling).

Across the Pacific Islands region, there is widespread and recognized need for alternative economic development to overcome poverty and meet the rising aspirations of Pacific islanders. Running counter to this is an increasingly vocal concern about impacts and a lack of communal benefit from development projects.

The focus of this chapter is the primary drivers of deep sea mining in the Pacific, with a shorter discussion on secondary drivers and the restrictive forces operating in the region (Table 1). Investigating these drivers provides an objective framework for improved understanding of the forces behind the industry, leading to better decision making. This investigation, like the industry, is in its infancy. Further work is required to better inform Pacific Island states of the factors influencing the future of the industry.

Drivers and restricting forces of deep sea mining

	Global	Industry	Pacific Island countries
Primary drivers	Global economic growth: supply and demand, population and consumption, increased industrialization and urbanization	Innovative, frontier field in an industry used to high-risk investment	Alternate development option: alleviate poverty, meet rising aspirations, lack of comparative advantage in other areas
	State actors: securing access to essential resources, capable of vertical integration of resource extraction and processing with product manufacture	Increasing difficulty and complexity of terrestrial mining: increasing costs, decreasing grade, slowing discovery, environmental issues, social and cultural issues	Marine minerals are a new natural resource capable of commercial exploitation in a region with few economic industries/choices
Secondary drivers	Growing societal aspirations for environmental and social sustainability	Technological improvements and scalable applicability	National independence and autonomy
	New uses/markets, the green economy		
Restricting forces	Price volatility	Availability of finance, financial uncertainty	Increasing community concerns about governance of, impact and returns from extractive industries
	Concerns over threats to marine environment, lack of marine science to inform conservation planning	Regulatory uncertanty in EEZ and the Area Significant obligations to share knowledge proceeds	Lack of governance, capacity, and regulation

Source: Charles Roche

Table 1. Drivers and restricting forces of deep sea mining in the Pacific, 2013.

3.1 Primary drivers of deep sea mining

3.1.1 Global economic growth

Over the past 20 years, the economies of China, India, and emerging markets in Southeast Asia, Africa, and Latin America have grown quickly. They are expected to continue to outpace developed nations in the years to come (Figure 3.1). The growth of emerging market economies and the financial recovery of developed economies will be key determinants for future demand for the mining and metals industry.

The world population is growing faster than at any time in history (Figure 3.2), accompanied by an even more rapid increase in mineral consumption as the global standard of living increases and a growing number of consumers enter the market for minerals (Kesler 2007).

The World Bank identifies China as the chief driver of metal demand over the past decade (Burns and van Rensburg 2012). Between 2000 and 2009, Chinese consumption of the main base metals (aluminium, copper, lead, nickel, tin, and zinc) rose 17 per cent per annum, a trend that continued during the recovery from the global financial crisis (Figure 3.3).

Behind the rise in the economic importance of these emerging countries has been the ongoing movement of people from the countryside to the cities, strengthening the demand for the commodities needed to construct cities (Figure 3.4). Long-term growth in emerging markets has a more significant impact on the mining industry than short-term economic fluctuations in the developed world (PWC 2012).

Globally, the size of the middle class (defined as those households with daily expenditures between $10 and $100 per person in purchasing power parity terms) is predicted to increase from 1.8 billion people in 2009 to 3.2 billion by 2020 and to 4.9 billion by 2030, with the majority of the population growth (85 per cent) located in Asia (Kharas 2010). The purchasing power of this group is forecast to increase from US$21 trillion to US$56 trillion by 2030 (Kharas 2010). Rising incomes lead to changes in consumption, with increased demand for durable goods, such as cars and white goods (household equipment) with high mineral and/or metal content (Kharas and Gertz 2010).

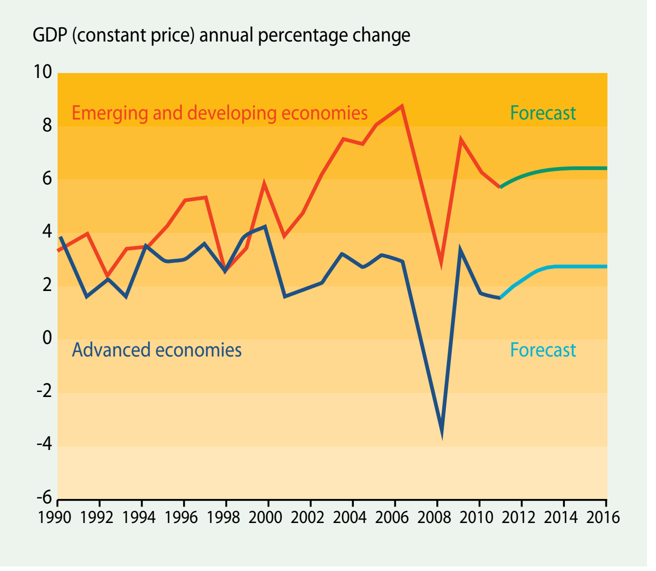


Figure 3.1 Gross domestic product: annual percentage change of emerging and advanced economies *(IMF 2013)*.

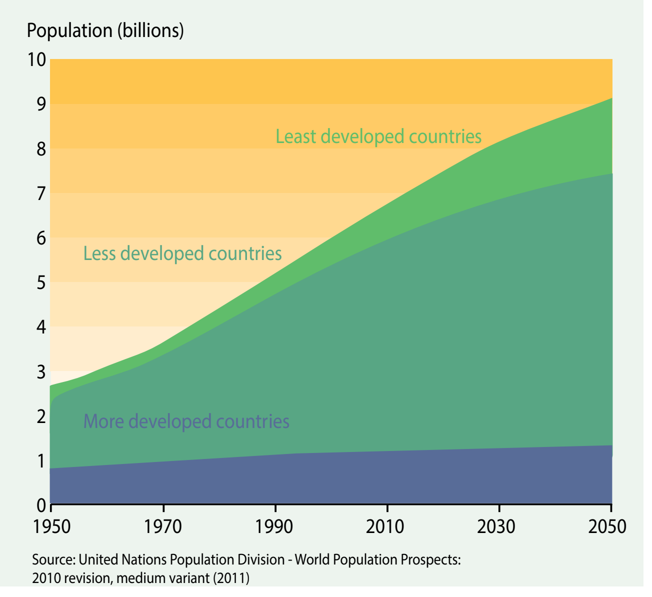


Figure 3.2 World population growth, 1950-2050 *(UNDESA 2011)*.

3.1.2 States securing access to resources

Exploration of the potential to mine the seabed has received investment and interest from both state and commercial actors. As countries develop, there is a national strategic interest in the minerals and natural resources that are key ingredients for the domestic manufacturing sector (Glasby 2000). To secure access to stable supplies of key commodities, nation states regularly support direct or indirect investment in resource projects. Japan is a case in point. It imports over 99 per cent of its oil and 96 per cent of its gas to support the domestic market. Key mineral resources used in Japanese manufacturing industries, such as copper and zinc, are also almost entirely imported.

Strategic investments for resource security may not be driven by an economic rationale for direct commercial profitability from mining if those investments sustain domestic industries, jobs, and living standards. China influences the commodities market through Chinese industry's heavy demand for raw materials and the timing of that demand, but also through its growing acquisition of shares in deposits and mining companies abroad (Bucholz *et al* 2012). The strategic interests of sovereign states like China, India, and Russia, which are seeking access to raw materials for infrastructure and manufacturing industries, may be a powerful driver for the future development of deep sea mining.

Today, the ownership of resources and changes to mining industry fiscal regimes are key issues for many governments around the world. States are generally looking for an increased share of mining profits as well as a secure supply of domestic resources. Ongoing discussions and debates, formal reviews of fiscal regimes, or legislative changes have been seen recently in Australia, Chile, Ghana, Peru, and South Africa. Increased export duties and export restrictions designed to encourage value-added downstream industries or protect security of domestic supply are being put into place in such countries as India and Indonesia.

At the more extreme end of resource nationalism, legislated local ownership and, in some cases, asset nationalization are impacting established producers in countries such as Indonesia and Zimbabwe. Governments are under pressure from local communities and other key stakeholders, with the result that the political and regulatory stability that previously existed in many mining nations is deteriorating. Nationalism continues to represent a significant risk for mainstream mining (E&Y 2012), although it is unclear whether this could have a positive or negative effect on deep sea mining.

3.1.3 Innovative frontier industry

There is a healthy appetite for risk in the mining industry, especially among start-ups and junior explorers. Trench (2011) acknowledges that successful explorers are in the minority, but sees many new mining frontiers. Deep sea mining is just another frontier in an industry that has thrived on risk and expansion into new areas. Indeed, finding new frontiers is a point of strength for the mining industry as a whole, even if many companies fail along the way.

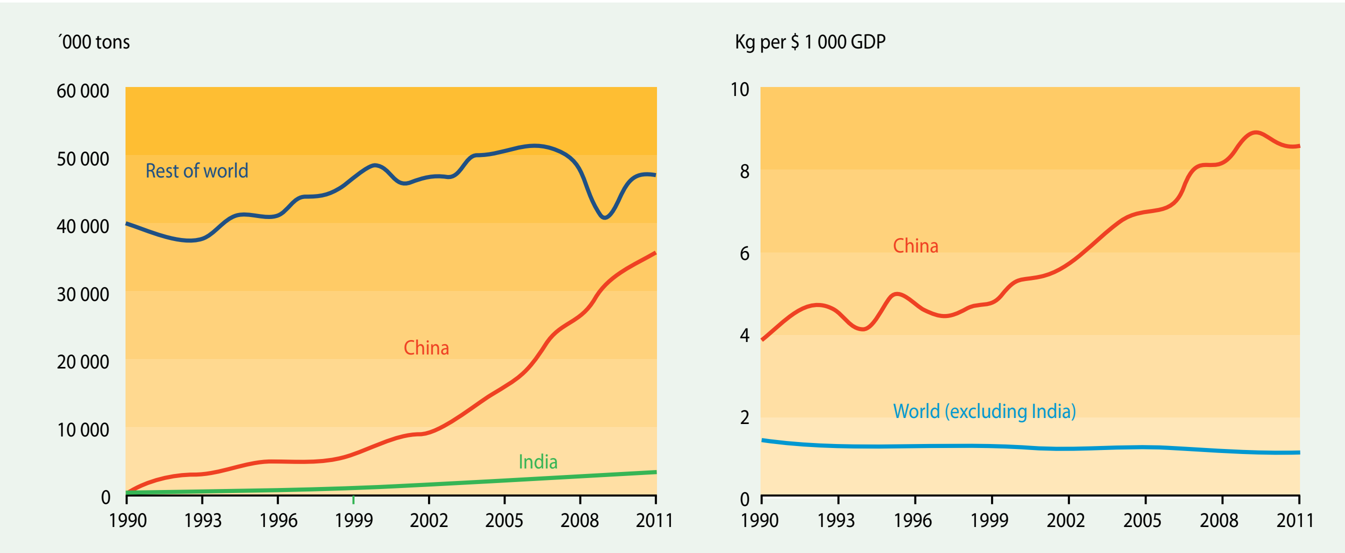


Figure 3.3 Refined metal consumption and metal consumption intensity *(World Bank 2012)*.

3.1.4 Increasing difficulty and complexity of terrestrial mining

The rate of discovery of accessible and high-grade terrestrial ore deposits is declining (Figures 3.5 and 3.6). The highest-grade ores have already been mined, and miners increasingly have to look at lower-grade deposits. Yield declines related to lower-grade ore increase the costs of production. If the grade is low, more waste is generated and processed to produce the same amount of a commodity (Figure 3. 7).

In conjunction with declining grades, input costs are rising. The largest 40 mining companies have widely reported increased contractor costs due to labour shortages and higher fuel and consumable prices. For non-US miners, this trend has been exacerbated by strong exchange rates against the US dollar. In the last decade, the mining industry has struggled to bring new mines into production on time and on budget (PWC 2012).

Despite record profits for the world's 40 biggest miners in 2011 (US$133 billion), market capitalization (the value of a company's shares) fell by 25 per cent (Figure 3.8) as shareholders demanding increased returns bought elsewhere (PWC 2012). Although net profits increased, net profit margins remained steady due to cost increases of 25 per cent. One implication of these trends is that investors might look for alternative mining investment opportunities, such as deep sea mining, if economic criteria demonstrate better potential returns.

While the sustained increase in consumption of metals and minerals is sending demand signals to the mining industry, it is becoming harder to extract ore on land economically and in an environmentally and socially acceptable way. Nevertheless, higher prices caused by the rapid growth in demand have led to a new mining boom, with companies expanding to newer mining countries in more remote and challenging geographic and geopolitical environments, such as Mongolia, Guinea, the Democratic Republic of Congo, Mauritania, and Afghanistan. There remains, however, a lag in supply, as new projects take years to be brought on-line (Giurco 2010).

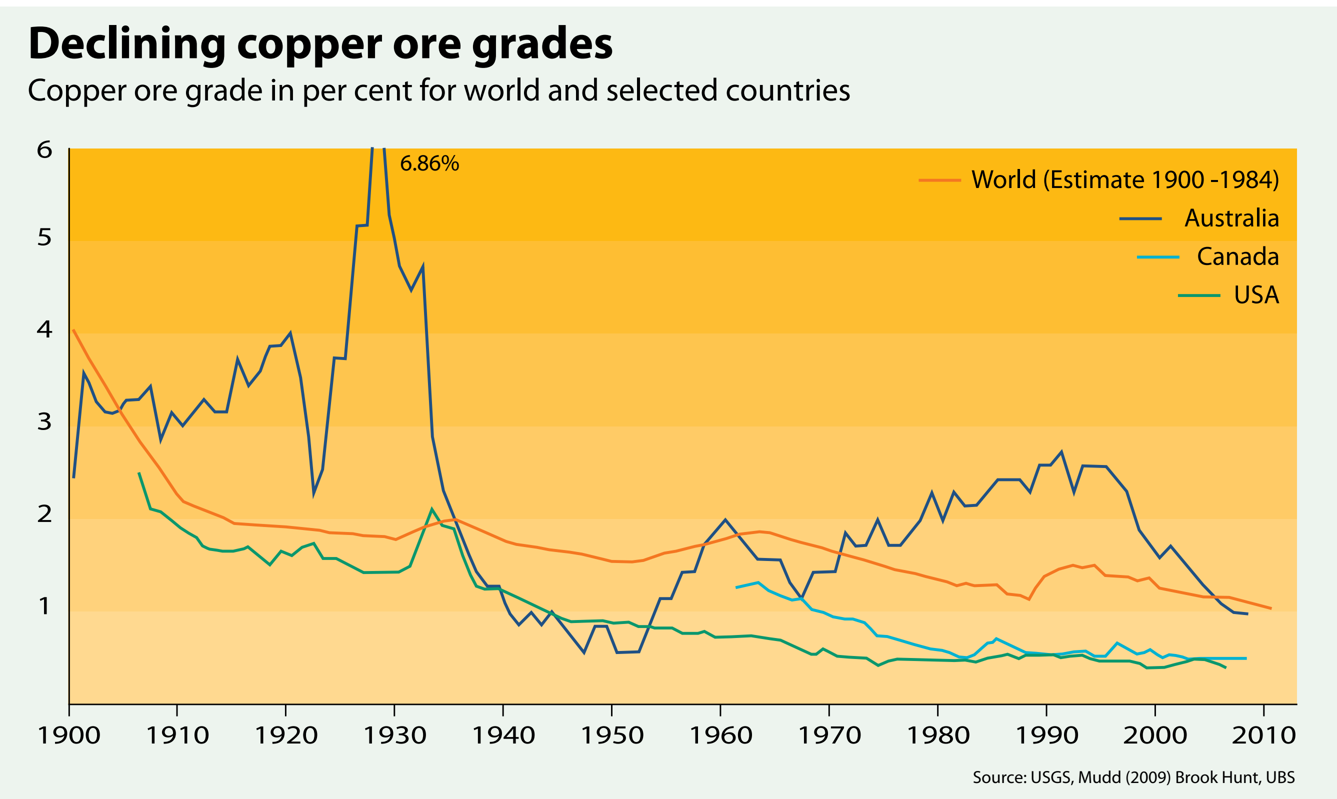


Figure 3.5 Declining copper ore grade over time *(Mudd 2009)*.

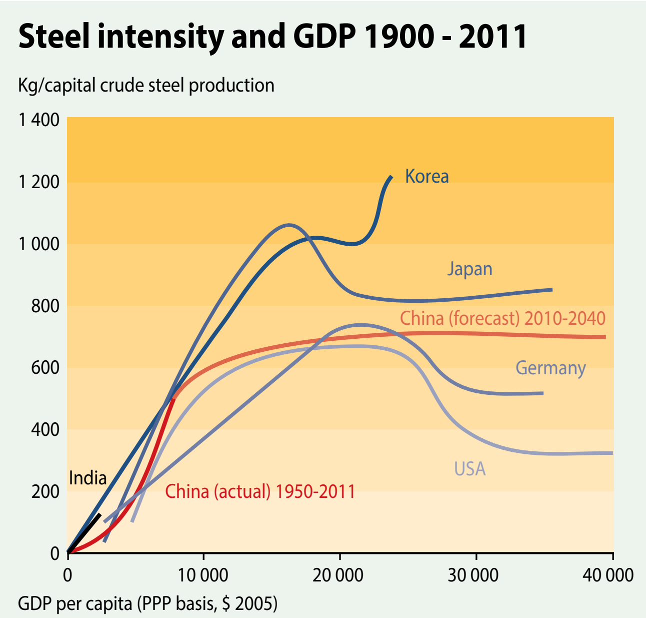


Figure 3.4 Relationship between steel production and GDP. *Steel intensity for China is yet to peak (Rio Tinto 2012)*.

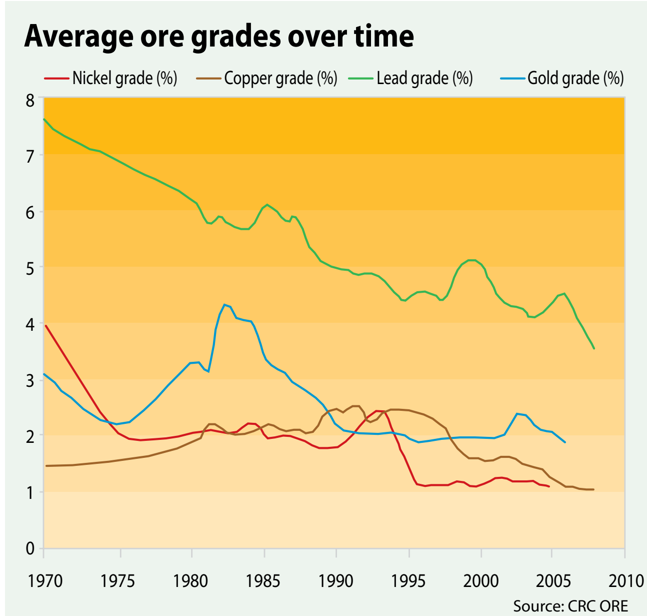


Figure 3.6 Declining average ore grades *(Mudd* et al *2013)*.

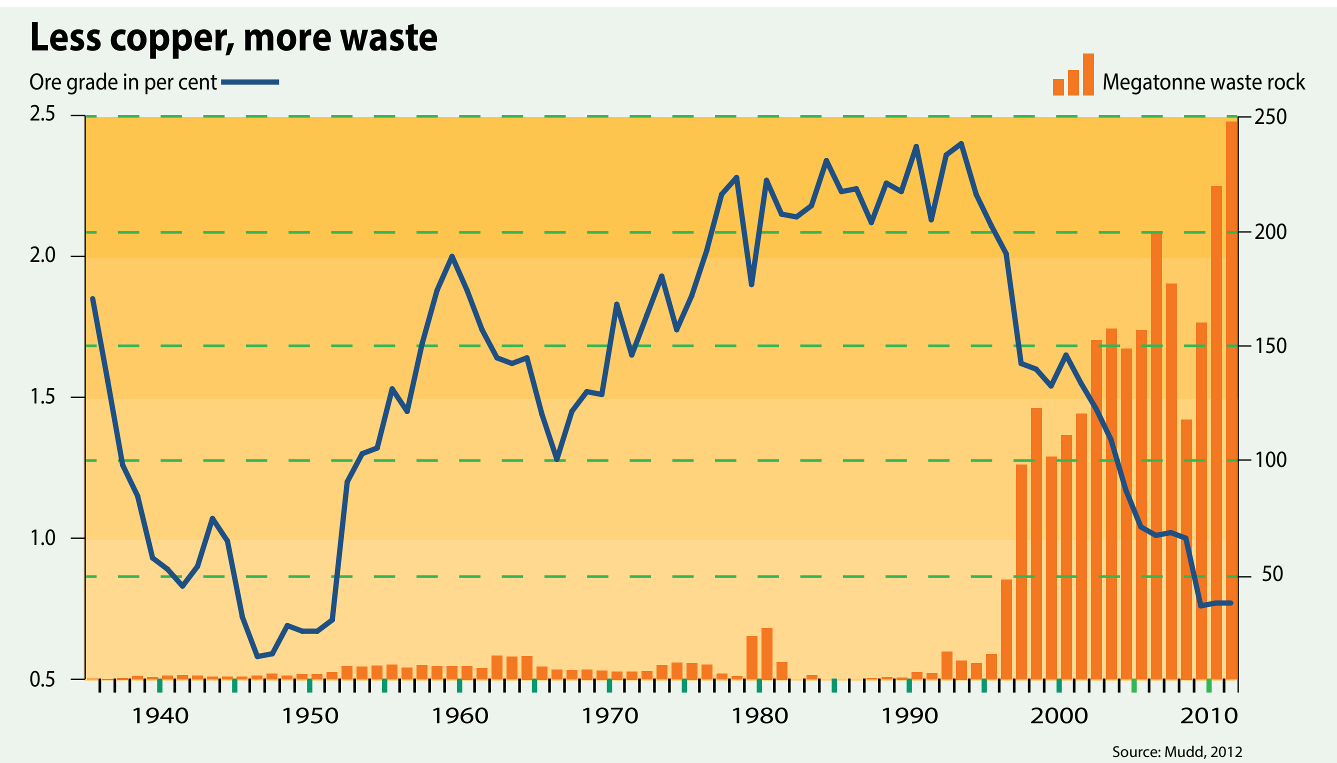


Figure 3.7 Increase in mine waste associated with lower ore grades *(Mudd* et al *2013)*.

3.1.5 Alternative development for Pacific Island states

The development of Pacific Island states is influenced by geography, geology, and economic size. The majority of states have a small land mass and population surrounded by a much larger marine jurisdiction (see SOPAC Division Strategic Plan 2011-2015 (SOPAC 2010) for details).

The main economic sectors for Pacific Island states are:

- services, such as remittances from the Pacific diaspora and tourism; and
- natural resource industries, such as agriculture, fishing, and forestry.

Data from 2010 (Figure 3.9) indicate that the Pacific Island states have a combined gross domestic product (GDP) of approximately US$15 billion, with US$11.7 billion coming from the region's two largest economies – Papua New Guinea (US$8.2 billion) and Fiji (US$3.5 billion). The remaining economies are much smaller, ranging from US$15 million in Tuvalu to US$668 million in the Solomon Islands. Most Pacific Island economies are relatively small, GDP per capita is low, and real GDP growth has been slow or negative for most over the last five years (UN ESCAP 2010).

Onshore mining industries are well established in Papua New Guinea and New Caledonia, and small, emergent, or inconsistent industries exist in Vanuatu, Fiji, and the Solomon Islands. However, for the majority of Pacific Island states, with their small land masses and low geologic diversity (including coral atolls), there is limited potential to develop onshore mines. The extraction of seabed resources could be especially important for those with limited land-based resources. Pacific Island states have responded cautiously but enthusiastically to the potential resource opportunity of deep sea minerals (Howorth 2011).

Deep sea minerals present Pacific Island states with an opportunity to diversify their economies and expand their mineral resource base, providing possible new revenue streams that could play an important role in meeting current and future development needs in the region. Deep sea mining is not, however, the only resource-based option available, and its viability and return to Pacific people need to be assessed against other, potentially competing opportunities.

While there have not been any deep sea mining profits generated to date, revenue and employment and education opportunities have arisen from exploration activities. If deep sea mining succeeds, it could provide income to states from multiple sources, including foreign investment, export earnings, and government revenues. Managed sustainably, this natural capital could be converted into jobs, infrastructure, public service improvements, and growth in the domestic private sector (Graedel *et al* 2011). The question for Pacific Island states is whether deep sea mining is currently viable and/or the most appropriate kind of development for meeting the needs of the Pacific.

Figure 3.8 Top 40 mining companies' net assets as percentage of market capitalization *(PWC 2012)*.

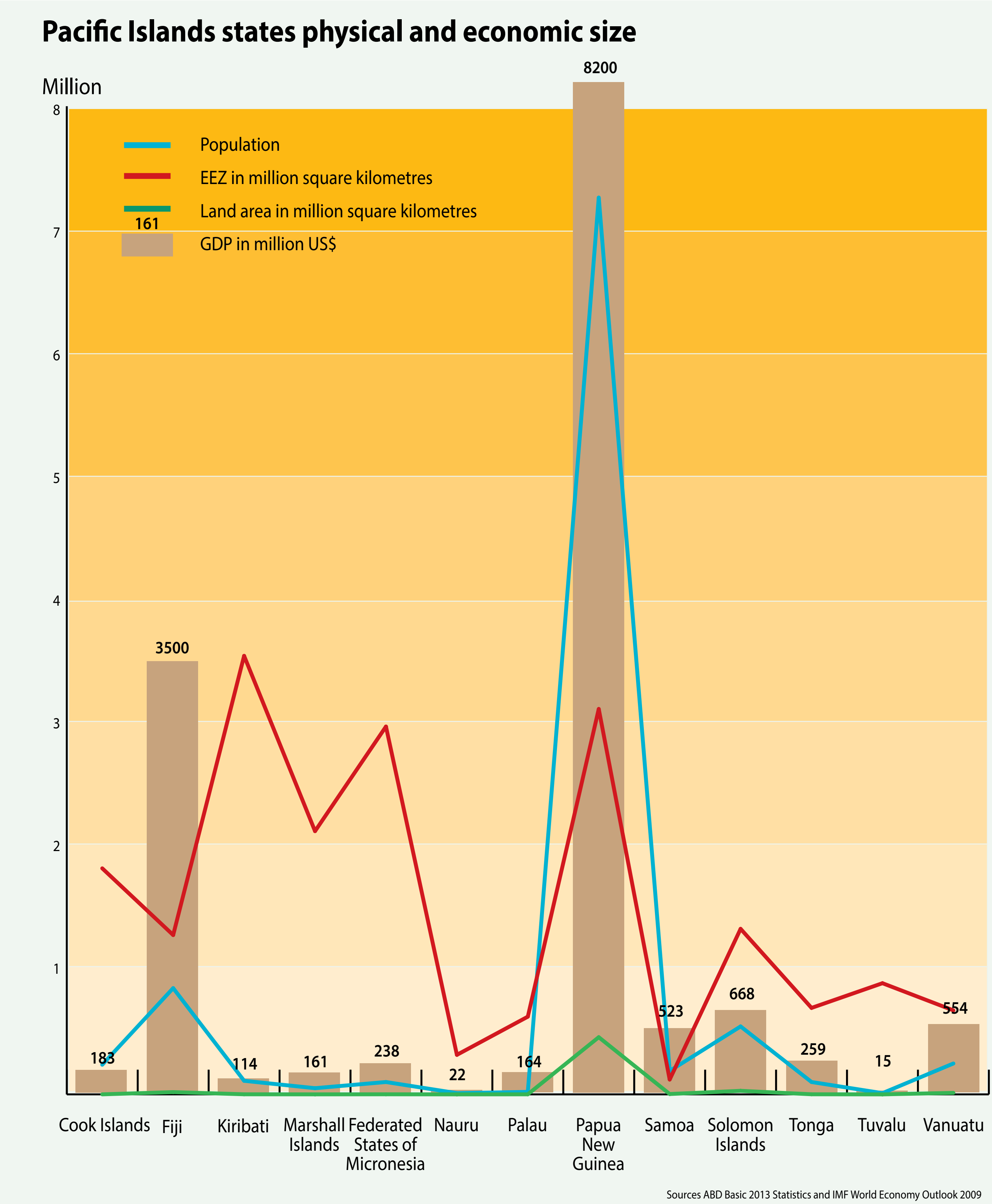


Figure 3.9 Pacific Island states: economic indicators.

3.2 Secondary drivers

3.2.1 Global: environmental and social sustainability, green markets

With its goal of intra- and inter-generational equity, sustainability has become a powerful social driver, able to influence projects, governments, and industries. This is evident in the increasing pressure on industry to comply with new community and government expectations and standards, despite the rising costs of complying.

Issues of sustainability are tied to, but not wholly concerned with, impacts from existing terrestrial mining. Sustainability is also linked with larger societal and global issues related to environmental impact, quality of life, and the transition to a green economy. Rising demand for clean-energy infrastructure to replace fossil fuels and reduce carbon emissions will place further demand pressure on metals. Many clean-energy technologies (such as wind turbines, solar power units, electric cars, etc.) are far more metal-intensive than traditional forms of energy, requiring far greater quantities of metal to produce an equivalent unit of energy output.

The transition to a green economy could drive deep sea mining in two ways. First, this global transition will place significantly greater demand on metal supply and will influence future metal price projections, thereby encouraging further investment in alternative sources of supply. Secondly, deep sea mining could provide Pacific Island states (many of which are particularly vulnerable to rising sea levels) with the opportunity to supply the world with the metals required to build these clean energy technologies.

3.2.2 Industry: technological improvements

Continued technological improvements are key to the successful exploration and potential exploitation of marine minerals. Since deep sea mining was first proposed, technologies have improved significantly (as demonstrated by depth capacities shown in Figure 3.10), largely driven by the oil sector. Some advances directly applicable to deep sea mining have become much more sophisticated and widespread, bringing the deep sea mining industry closer to commercialization. These include:

- subsea equipment (such as sonar, underwater servicing and repair equipment, high-power electro-optic umbilicals, subsea cables, electric motors, hydraulic power units, cameras, etc.);
- autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs) for sea floor mapping;
- risers, pipe handling equipment, and pumping technology; and
- advances in vessel size and functionality, semi-submersibles, GPS systems, and bulk materials handling at sea.

More significant, novel or leap-frog advances in technology, such as bioprocessing or depth technologies, could make technological improvement a more significant driver of the industry. At this time, as deep sea mining competes with terrestrial and recycled sources of metals, the key issue is what is technically and economically feasible.

3.2.3 Pacific Island states: national independence and autonomy

The need for independence and autonomy is common to states of all sizes throughout the world. With its recent history of decolonization, much of the Pacific region is still struggling to achieve truly independent status. Many Pacific Island states are still dependent on development aid. While there is a desire for greater autonomy, few Pacific Island states currently have prospects capable of delivering genuine economic independence (Levine 2012). The emerging prospect of deep sea mining should be recognized, then, as a new possibility not just for development, but for empowerment and autonomy.

Worldwide progression of water depth capabilities for offshore drilling and production (as of March 2011)

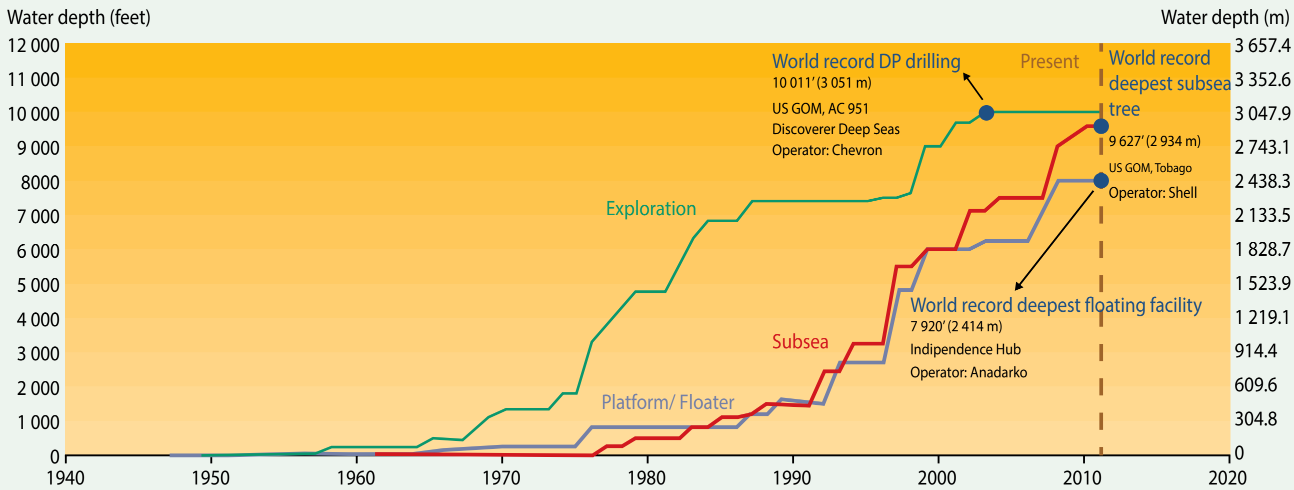


Figure 3.10 Worldwide progression of water depth capabilities for offshore drilling and production. *(Source: Mustang Engineering)*

3.3 Restricting forces on the development of deep sea mining

3.3.1 Global: price volatility and conservation

Commodity prices, as well as stock and currency volatility, represent significant risks to the mining industry generally, creating difficulties in financing and uncertainty for investment return ratios (E&Y 2012) – which is likely to pose a particular challenge for the pioneering and unproven seabed minerals industry. Indeed, (Glasby 2002) identified the collapse in world metal prices at the beginning of the 1980s as a reason for the indefinite postponement of nodule mining.

More recently, Martino and Parson (2012) have identified price volatility (Figure 3.12) as the most important parameter affecting investment in deep sea mining and predict that, without technical improvement or falling costs, we can expect a postponement of nodule exploitation for one or two decades, with greater uncertainty for crust exploitation.

3.3.2 Conservation movement

The importance of identifying and managing potential environmental impacts from deep sea mining has been recognized not only by international law (see Chapter 6) but also by proponents, financiers, and Pacific Island governments. In response, the industry has produced a voluntary code for environmental management, which identifies operating principles and guidelines for application (IMMS 2011). However, local concerned communities (see section 3.3.4 below and Chapter 5) are increasingly vocal, and opposition groups are joining with international movements to express concerns about the perceived lack of information on the potential impacts of deep sea mining and fears of adverse impacts (Small 2011; Van Dover 2011; Dawea 2013). Lack of in-country capacity, the nascent nature of seabed mineral activities, and the lack of a clear process for independently evaluating and sharing scientific research (non-commercial information) has hampered knowledge sharing and informed discussion among Pacific Island states.

3.3.3 Industry: financial uncertainty, regulations, and obligations

Since the global financial crisis, continued uncertainty is significantly diminishing the risk appetite of capital providers and the ability of junior miners (a term for small mining or exploration companies often relying on venture capital) to raise funds (E&Y 2012). Aspiring junior deep sea mining companies will have to compete for finance with mainstream mining, which has a more mature and understood risk profile.

The pressures on junior miners are evident in recent data that reveals the absence of initial public offerings on the Toronto Stock Exchange (TSX) and only three mining issues on the combined London Stock Exchange (LSE) in the first quarter of 2013 (LSE 2013; PWC 2013). This is a marked change from the same quarter in 2012, when 12 mining companies listed on the TSX and 8 on the LSE. While this represents a tightening financial market, there is anecdotal evidence of a shift to debt funding and increased activity from private equity firms, which could provide the required capital to commence deep sea mining (PWC 2013).

Regulatory risks are also a restricting factor for deep sea mining proponents. The lack of dedicated deep sea mining legislation, regulation, and enforcement regimes in many Pacific Island states' EEZs creates further uncertainty and could potentially hinder process and equipment transfer from one jurisdiction to another. Further complications can arise if official approvals of mining do not constitute community consent or a social licence to operate.

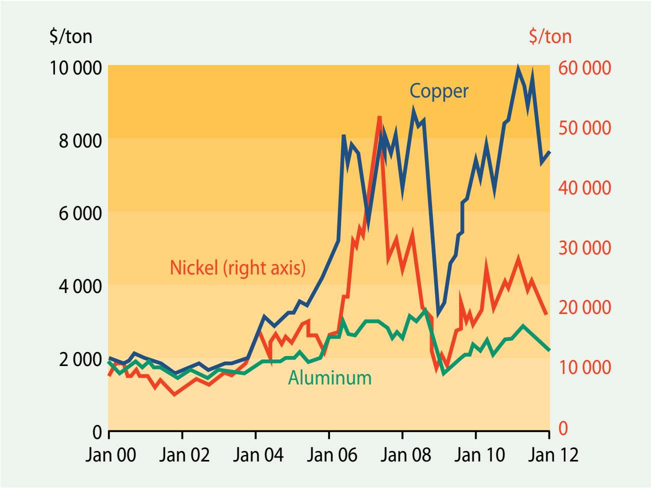


Figure 3.12 Metal price volatility *(World Bank 2012)*

Ironically, while the absence of dedicated legislation is problematic, so too is overly restrictive legislation. The provisions of the ISA's Mining Code, which force technology transfer and reserved site banking, are disincentives for the development of deep sea mining in the Area (Glasby 2000). These obligations could become a driver within Pacific Island national jurisdictions, where there might be greater legal and regulatory certainty, relatively unaffected by the global politics of the Area.

3.3.4 Pacific Island states: community concerns and governance

Community concerns about deep sea mining from Pacific Island states are a counter-force against the push for economic development. While the specific concerns are discussed elsewhere, it is salient to note the dampening effect that increased criticism of and opposition to deep sea mining could have on the currently high levels of enthusiasm from Pacific Island governments. The delay in project commencement at Solwara 1 in Papua New Guinea is a good example of this. While the relationship between community opposition, financial uncertainty, and the contractual grievance between Nautilus and the PNG government is unclear, the delay is, at least in part, attributable to community action.

The importance of addressing governance issues was made clear at the SPC-EU Deep Sea Minerals Inaugural Workshop held in Fiji in June 2011. Areas where the need for action was identified included:

- developing national policy and laws;
- ensuring adequate accountability and transparency;
- addressing undue political interference or corruption;
- building in-country or regional capacity to monitor operations and to enforce compliance;
- ensuring the presence of watchdogs, such as civil society and auditors;
- strengthening negotiations in order to strike an equitable balance between the needs of Pacific Island states and the interests of industry;
- establishing politically isolated sovereign wealth funds; and
- signing up to the international standard, the Extractive Industries Transparency Initiative (EITI) (Howorth 2011).

These points demonstrate a keen understanding by Pacific Island representatives of the need for effective governance to assess, regulate, or benefit from deep sea mining in the Pacific.

During a workshop on environmental needs, co-sponsored by the SPC-EU Deep Sea Minerals Project and the International Seabed Authority and held in Fiji November-December 2011 (ISA 2011), parallels were also drawn with the Pacific tuna fishing industry (ISA 2011). As a Pacific-wide industry, it provides a cautionary tale of development and governance. Briefly, despite high expectations of shared economic benefits from the fishing industry, the Pacific Island states were unable to convert their new marine rights into economic success. Weaknesses in governance made the countries vulnerable to corruption along the production chain. While some steps have been taken to improve governance and reduce corruption, it remains a significant issue (Schurman 1998; Barclay and Cartwright 2007; Hanich and Tsamenyi 2009).

Further concerns about the ability to respond effectively to the deep sea mining industry were expressed at the SPC-ISA 2011 workshop. In particular, current funding for monitoring, management, and regulation of mining-related activities within the Area was seen as inadequate. Furthermore, the ability of Pacific Island states to engage in either the national jurisdiction or the Area was hampered by gaps in current assessment and management structures and processes. Unless these capacity gaps are addressed, the Pacific Island states could struggle to respond to proposals effectively, which could result in poor outcomes, delays, and loss of confidence.

While governance is a national responsibility, mining companies are increasingly affected by and expected to deal with governance issues. In 2003, the World Bank's Extractive Industries Review recognized the importance of good governance by recommending it be included as an enabling condition, prerequisite to mining development (World Bank 2003). More recently, its importance is evidenced by its entry into Ernst and Young's top ten business risks for mining and metals in 2011 and its continued appearance in 2012, alongside social licence to operate, resource nationalism, and sharing the benefits (E&Y 2012).

3.4 Discussion

The factors driving and restraining deep sea mining in the Pacific are complicated, dynamic, and interrelated. Moreover, these factors may be global, industry-wide, or regional in scope and may leave smaller companies and states at the mercy of elements outside their control.

On one hand, a sudden change in demand caused by innovation or substitution, or a change in supply of an essential commodity – such as the pit collapse at the Bingham Canyon mine, which produced two per cent of global copper in 2010 and 2011 (Romboy 2013) – could provide an additional trigger for the adoption of deep sea mining. On the other hand, rising demand could shift from one commodity to another within the typical mine development schedule of 10 to 20 years or more, making it difficult to justify the investment in non-mainstream mining.

While the development of deep sea mining has so far been the province of small corporate entities, that is not the only option. A fast-tracked deep sea mining production scenario could result from the increased involvement of state-owned mining enterprises or the entrance of industry-dominating multinationals. Lockheed Martin's announcement in May 2013 that the company would be exploring in the Clarion-Clipperton Zone is an indication that larger companies could accelerate exploration and mining activity.

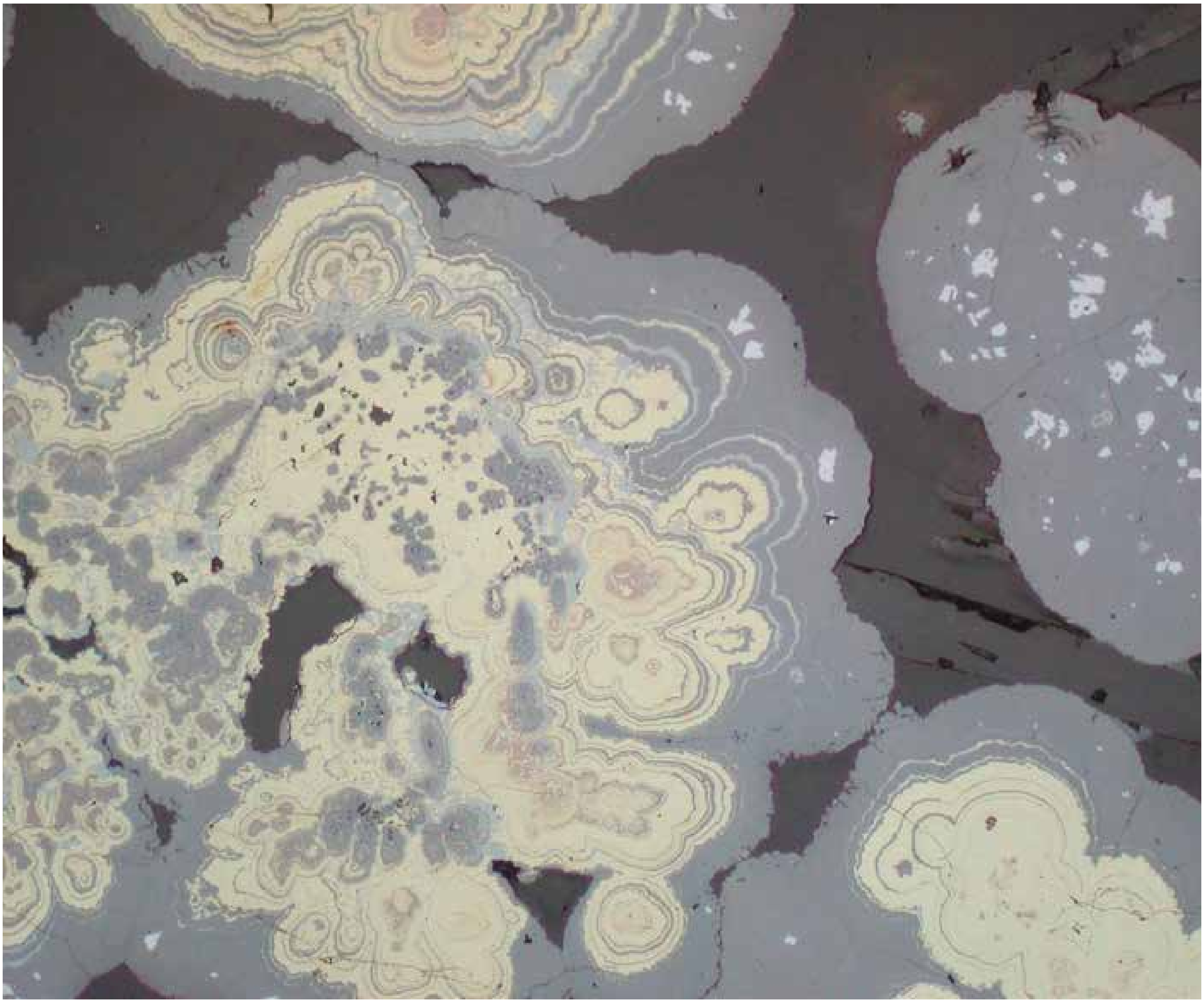
Without these actors, price volatility, market instability, and lack of finance, together with global and Pacific deep sea mining concerns, may combine to diminish the attractiveness of commercial investment in the industry and delay its development in the Pacific. Whatever the cause, ongoing delays in projects or unsuccessful project implementation could continue to erode confidence and further set back commercialization by many years.

Some commentators have suggested that deep sea mineral exploration is inevitable (Yeats 2012). Others are far less certain of its viability in the near future (The Economist 2009; Jha 2012; Martino and Parson 2012). The fact that seabed extraction is not mainstream mining is certain. The industry will require specialized knowledge, technology, regulations, and stakeholder support to generate sufficient confidence to invest in and develop deep sea mining projects. This is a "Catch-22": without successful projects in operation, there remains a substantial information and confidence gap between investors and stakeholders.

While there may well be environmental and social advantages to seabed mining in comparison to terrestrial mining, this remains to be tested in practice. However, the global focus on sustainability is unlikely to change. If the deep sea mining industry can prove its green credentials, it might secure better access to markets, access to essential finance, or even a higher price for a premium product.

In conclusion, there are significant, but not insurmountable, challenges to overcome before the deep sea mining industry is recognized as economically viable or as a sustainable industry that can make a positive contribution to Pacific Island communities. While deep sea mining represents a new opportunity for Pacific Island states, the situation will continue to be dominated by strong external influences over the key drivers. When combined with uncertainty and variability, this means Pacific Island states have little direct influence over many of the drivers of deep sea mining.

At the same time, however, there is some significant enthusiasm within Pacific Island states for deep sea mining and the contribution it could make to Pacific development. There are some factors that these countries can control and that will help the industry progress. They include continued knowledge sharing and the development of capacity and governance structures (including regional mechanisms) to ensure a stable and transparent environment that encourages industry participation.


Massive sulphide sample from PACMANUS PNG, viewed under the microscope. Photo courtesy of S. Petersen, GEOMAR.

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4.0 Sustainable Economic Development and Deep Sea Mining

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Ensuring that deep sea mining will have a positive impact on Pacific Island communities requires supporting not only the economic capital upon which sustainable and resilient economies are built, but also the social and environmental capital. In this chapter, we will explore the potential benefits and costs of deep sea mining to the economic and environmental capital of coastal and small island developing states in the region. We also look at traditional and emerging ways to determine the economic, environmental, and social costs and benefits of mining.

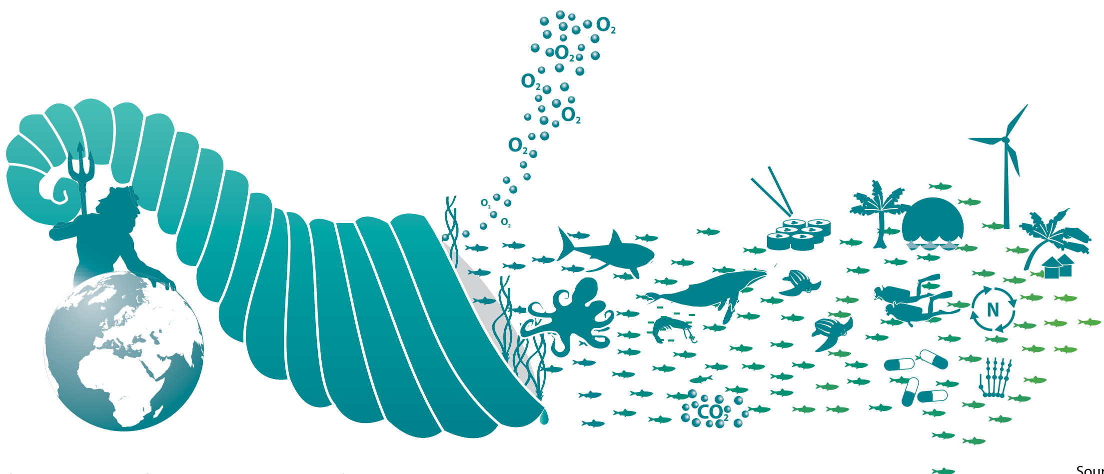
4.1 Background: the oceanscape of the Pacific region

Almost all of the currently estimated 10 million South Pacific islanders (expected to reach 15 million by 2035 (SPC 2013)), live within 50 kilometres of the coast. The ocean territory, which far exceeds the Pacific islands' land mass, has shaped the lifestyles and culture of the people. The ocean provides fish, shellfish, and sea plants that support both local communities and commercial fisheries. Coastal coral reefs and mangroves mitigate the impacts of storm surge and protect beaches. Coastal habitats provide firewood, fibres, and other resources. Ocean views are known to improve people's well-being (Millennium Ecosystem Assessment 2005). Many coastal communities benefit from tourism, which generally relies on clean beaches, safe water, and abundant marine wildlife. Tourism generates jobs, income, and foreign exchange. Ocean recreation provides both market and non-market benefits to coastal residents. Ocean ecosystem processes provide ecological services and are an integral component of other global processes, such as the water cycle, nutrient cycling (including carbon storage), primary production of oxygen, and the regulation of climate.

The deep sea may now offer new opportunities for industrial development, including the extraction of minerals from the deep sea floor. Many existing industrial marine activities occur in the near-shore environment, whereas deep sea mining activity is anticipated to be far removed from the coastal and shallow-water ecosystems that are so important to many Pacific communities. The lack of direct human uses of ecosystems and their services in the deep sea, combined with new technological advances, means that deep sea mining could potentially have lower environmental and social impacts than land-based mineral extraction (see Chapter 3 in this volume). Nevertheless, impacts could result, both onshore and offshore. The lack of information about the ecosystems at depth and about the technology that will be employed in commercial extraction activities offshore means that there remains scope for unforeseen and direct impacts. Additionally, the deep sea environment presents difficult working conditions and unique technical issues that may make environmental monitoring and/or revenue collection difficult and costly.

To ensure that any development of deep sea mining improves the overall well-being of society, it is essential to understand each of the potential costs and benefits and their cumulative effects. Wealth creation from the sale of non-renewable resources needs to be weighed against any associated reduction in the economic value of other goods and services. By understanding this balance, policy makers can implement measures to ensure that the environmental and social costs of deep sea mining are managed and outweighed by the social benefits and economic returns from mining – and that these returns are invested and distributed equitably.

World oceans, a cornucopia of goods and services



Source: GRID-Arendal

Figure 4.1 Marine ecosystem services

4.2 A green economic approach to managing deep sea mining

Pacific Island developing states could potentially benefit from seabed mining if these activities contribute to Pacific economies in a way that is both financially productive and also green. A green economy is one in which market forces and opportunities are coupled with environmentally sound technologies to maintain or improve the economic, social, and environmental resource base on which coastal communities depend. (See UNEP's report Green Economy in a Blue World for additional information, UNEP et al (2012)). In a greener economy, industry and business can contribute to creating new sources of income and jobs, while reducing the use of resources and the generation of waste (Figure 4.2). A green economy can also contribute to broader societal goals, such as sustainable development, social equity, and poverty reduction. A green economy can be viewed as an economic system that is compatible with the natural environment and ecosystems, environmentally friendly, and socially just (Sheng 2010).

Historically, Pacific communities have invested in their own welfare by converting their natural resources (fish, forests, mangroves, sand, etc.) into something of economic value. The conversion of natural capital into economic capital has been environmentally sustainable in many Pacific Island states, especially when the scale has been small and rules, whether formal or not, have been in place to limit impacts on living environmental resources. These rules are often based on an understanding of natural systems acquired over generations.

As an example, in the Pacific, taboos on fishing have commonly been used to manage where and when fishermen could catch fish in such a manner that fish stocks are maintained and continue to provide for the community. Managing these renewable resources effectively meant giving something back: in this instance, the time and space necessary to replenish ecosystem services.

This approach to using renewable resources ensured that the wealth from fisheries was ongoing, or sustainable. Sustaining the wealth generated from non-living resources, however, requires a different approach since non-living resources, such as deep sea minerals, cannot be replenished. To account for the contribution of natural capital to economic growth, deep sea mining profits need to be invested in social and environmental capital, as well as in other forms of economic capital. To support social capital, investments could create infrastructure and amenities that support the community, such as schools, hospitals, and other community facilities. Similar investments could be made in environmental protection or restoration,

Figure 4.2 Principles of a green economy.

Three types of capital needed for a greener and more resilient economy

"A green economy is one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive." (UNEP 2011)

A green economy is more holistic than a traditional economy focused primarily on economic growth. Instead, it recognizes three kinds of capital:

- Economic capital refers to standard forms of industrial capital, including infrastructure such as roads, communications, plants, and equipment.
- Social capital includes knowledge, skills, and experience comprising the ability of human beings to contribute to the production of economic value, as well as the broader social fabric in which it is embedded. This includes contributing to the cultural underpinnings of social institutions that, in turn, contribute to peace and sustainability.
- Natural capital includes the ability of the environment to support and produce goods and services that people value.

A green economy endeavours to maximize returns on social and natural capital, as well as economic capital (Figure 4.3). In a green economy, no single form of capital grows disproportionately at the expense of the others (Figure 4.4). All three forms of capital can be depleted, but, if equitably maintained, they can result in more resilient economies that produce sustainable value for the benefit of people.

Figure 4.3 The three capitals of a green economy.

Figure 4.4 Balancing the three capitals.

thereby improving the value of local natural capital. In this respect, communities can obtain a net beneficial return from the extraction of sea-floor minerals.

More generally, insufficient investment in social capital means that poverty could persist in the Pacific, despite any wealth that might be generated by mining. As an example, extensive mining development has been undertaken in Papua New Guinea in recent decades. Despite this, Papua New Guinea's GDP per capita (recorded as $US2187 in 2012, ranking 179th of 229 countries worldwide; World Bank 2013) and human development index (recorded by UNDP in 2013 as 0.466, ranking 156th out of 187 countries worldwide; UNDP 2013) are still low, and poverty remains in the communities close to the mines. This appears to be due to inadequate institutional capacity, ineffective management, and inequitable capture and reinvestment of resource rents. Lal and Holland (2010) give examples of corruption, in which the wealth generated from the use of community-owned resources in Papua New Guinea has been managed in a way that has not benefited local communities.

Deep sea mining could contribute to a greener economy if:

- the economic benefits of deep sea mining exceed their economic costs;
- the environmental component of the costs of deep sea mining is adequately understood by all and is incorporated into the decision making of deep sea mining companies (including management of consequences, as appropriate); and
- a sufficient share of the wealth generated by mining (for example, through taxes or royalties) is invested in social and environmental capital in order to ensure the sustainability of wealth creation from finite resources.

Limits to reinvestment of economic capital in natural capital: phosphate mining

The island of Kiribati provides an example of the value of investing the economic capital gained from a non-renewable resource in social capital. In the past, international companies carried out extensive phosphate mining on the island of Banaba. As early as 1956, it was realized that the phosphate resources were limited and a trust fund – the Revenue Equalization Reserve Fund (RERF) – was established to manage the earnings from phosphate mining. Since then, interest from Kiribati's phosphate royalties has been available to the government and continues to be a critical source of budgetary income. In 2009, the fund was valued at around US$570 million (IMF 2011).

Nevertheless, reinvestment in social and natural capital can only go so far towards ensuring basic levels of environmental quality. For instance, phosphate mining can still lead to irreversible environmental damage if appropriate environmental limits are not set. Phosphate mining has dramatically reduced the agricultural and fishing potential of more than one Pacific Island state.

4.3 Assessing the economic impacts of deep sea mining

Like any type of resource use, extracting deep sea minerals and getting them to market can contribute to local environmental change, which could directly or indirectly compete with or displace other types of economic activity.

4.3.1 The potential market benefits and costs of deep sea mining

Private companies are beginning to consider commercial deep sea mining because the minerals found on the sea floor have substantial value on the world market. The net market benefit of these resources (that is, profit) depends not only upon the market price of minerals and metals, but also on the financial costs of exploration, permitting, management, extraction, and processing. The primary economic interest that Pacific Island states have in allowing or participating in deep sea mining is securing sales revenue by way of royalties on mineral production, taxation on profits, or access fees from foreign companies that require sovereign permission to access sea-floor resources. Such revenue, if managed well, could inject new wealth into national economies and have ripple effects throughout the national economy.

In Papua New Guinea, for example, over the period 1996 to 2000, the government raised revenue from mining through royalties, a mining levy on assessable mining income (in effect, an additional royalty), corporate income taxes and dividend -withholding taxes, an additional profits tax, and restrictions on deductions for off-site exploration expenditures (Otto *et al* 2006). In addition, the state reserved the right to assume up to a 30-per-cent equity share in all projects at the time a mining lease was issued, at a price based on the project's exploration costs, not its full market value (Otto *et al* 2006).

Although these charges were subsequently reduced and streamlined, the magnitude of the potential wealth from mining in Papua New Guinea remains high, with mining consistently contributing between 10 and 20 per cent of national income over the years (Figure 4.5). Part of this wealth is also intended to reach communities, with the Papua New Guinea Mining Act requiring that owners of private land being mined receive a share of the total royalty (Otto et al 2006).

In practice, the degree to which these net market benefits will be enjoyed nationally or locally will depend on a host of factors. At a minimum, Pacific Island states could capture a share of the economic return from mining by charging fees, taxes, and royalties, which provide public sector revenues that could be reinvested locally.

Deep sea mining is anticipated to be expensive. It is capital-intensive, requiring large expenditures on vessels and equipment, processing, and transportation (although, in contrast to land mining, much of the machinery is designed to be moved from site to site). Some of the expenses associated with deep sea mining operations might be spent in the host country, which could create macro-economic ripples leading to new jobs and revenues in the host country.

Deep sea mining could also provide direct employment opportunities for a host country, indeed, this can be made a condition of relevant mining law and agreement. But such employment will depend upon the degree to which the administration, transport, and technical operations related to mining can be based locally. Potential sources of direct employment include shipping, aviation, warehousing, maintenance, construction, regulation, and monitoring (including laboratory services). In countries with well-developed labour forces – especially those where terrestrial mining already exists – highly skilled or technically specialized positions could be created for locals. In other Pacific Island states with less developed labour pools, migrant workers might (at least initially) fill highly skilled positions that could provide a basis for capacity building and technology transfer opportunities, benefitting the social capital of coastal and small island developing states.

Indirect employment – in hospitality, lodging, and provisioning industries, for example – could be generated if mining operations buy goods and services locally. Mining operations might also require the development of new local infrastructure (such as roads, ports, and power plants) that could serve to support or spur needed infrastructure development in host countries – although there has, to date, been little indication from industry actors in the region that onshore services would be sought from Pacific Islands. If as seems likely, operations in the Pacific take place wholly offshore, with the seabed mineral ore being transported by boat out of the region's ocean and directly to countries (perhaps in Asia) with established processing industries, then the potential benefits to be derived from employment or infrastructure development should not be overstated.

Papua New Guinea gross domestic product from mining activities

Activity / Year	1997	1998	1999	2000	2001	2002
Mining and quarrying (US million $)	307	358	385	605	542	456
Gross domestic product (US million $)	1 760	1 711	1 840	4 158	4 270	4 357
Per cent of GDP from mining	17.5	21	21.5	14.6	12.7	10.5

Source: National Statistical Office of Papua New Guinea

Figure 4.5 Gross domestic product from mining in Papua New Guinea. *Source National Statistical Office of Papua New Guinea (2004)*

4.3.2 The potential non-market benefits of deep sea mining

Exploration and exploitation of the sea floor will contribute to advances in technology and scientific understanding of these areas. Already, exploration of the sea floor at potential mining sites (the Solwara 1 site within Papua New Guinea's national jurisdiction and the Clarion-Clipperton Fracture Zone of the Area) has led to the discovery of previously unknown species and new information on biological processes (Van Dover *et al* 2012). It is difficult to attribute an economic value to these scientific discoveries (although some commentators consider that genetic resources might be the real treasure to be found at depth in the ocean), but it is clear that the costs of conducting research in the absence of commercial exploration, driven by potential mining profits, would likely be prohibitively high.

The potential economic benefits of technological advances are also difficult to quantify, but fall into two categories:

- advances that will improve the feasibility and profitability of future deep sea mining; and
- advances that will benefit other industries (such as deep sea tourism, cable laying, etc.).

In all cases, these benefits are unlikely to be enjoyed directly by the mining company, or even the Pacific Island states, but will have substantial economic benefits outside the region.

As noted, some habitats, organisms, and ecosystems that could be affected by deep sea mining might contribute to people's economic well-being. Examples include food sources for commercially relevant fish, opportunities for scientific research, or potentially valuable genetic resources for biotechnology or medical applications. Future tourism to deep sea areas via submarine or through images is also a possibility. Commercial fishing, scientific research, and tourism all have direct value, known as use value, which can be estimated by market and non-market methods. If deep sea mining has detrimental impacts on these ecosystem services, the loss of value associated with these changes should be understood and considered by policy makers.

Deep sea mining is presented by some mining companies as a more environmentally sound alternative to terrestrial mining for similar minerals (see Chapter 3). Whether or not deep sea mining will ever displace terrestrial mining depends on a host of factors, including market forces, regulations for terrestrial and sea-floor mining, and the degree to which environmental externalities are incorporated into the cost of doing business.

4.3.3 The potential non-market costs associated with deep sea mining

It is possible that deep sea habitats, ecosystems, and organisms have value that is not associated with direct use, including the value people place on simply knowing they exist (existence value), the value of saving these deep sea areas for future users (bequest value), and the value of future potential uses for these deep sea areas (option value). Such values depend, in part, on our understanding of the ecosystems, and some recognition of potential future uses (for example, biotechnologies, medical applications, recreation sites, linkages to proximate benthic and pelagic ecosystems, etc.) may be warranted. Our knowledge of these systems and of the options for potential future use is likely to grow rapidly with further exploration and research.

Environmental changes that could result from deep sea mining

Deep sea mining will cause direct physical changes in the structure of the seabed, as well as in the quality of the physical environment and the nature of environmental processes in the immediate vicinity (see Volume 1 of this series). Mining of sea-floor massive sulphides and cobalt-rich ferromanganese crusts might require strip-mining techniques that use remotely operated underwater cutters to remove the ore. Manganese nodule mining might use a vacuum system. Strip mining and sea-floor vacuuming could destroy the physical habitat of deep sea-floor areas and associated biota (see Elements of Production, below). Without careful controls, deep sea mining could release particulate matter into the water column, both from the cutting process and from the return of turbidity-laden seawater from the shipboard dewatering process (Hoagland *et al* 2010). This release could be detrimental to organisms living close to the mine site, and potentially also those farther away.

Access to some parts of the sea may be diminished if deep sea mining activity at the lift/riser site requires a management or exclusion zone. Similar access restrictions could occur due to the marine traffic associated with support vessels. Noise, sediments, and other associated factors could create a de facto exclusion zone. Displacement of artisanal or industrial fishing would result in a further cost associated with mining activities.

Mining might also affect nearby organisms through the introduction of invasive species, toxic substances from the deposit, spilt ore, and such pollutants as hydraulic fluids, noise, and vibration. In addition, mining introduces light into an otherwise dark world, which could potentially interfere with the feeding and reproductive behaviour of organisms (Nautilus Minerals 2008).

Getting marine minerals from the sea floor to market requires a production chain that could affect a wide range of environments, not only those directly associated with the deposit. Onshore operations, which may include infrastructure development, ore transfers, crew transfers, and minerals processing and transport, have the potential to affect local water and air quality and result in carbon emissions. A reduction in local environmental quality could also pose a public health risk to local communities. The potential economic costs of these environmental damages have not yet been estimated.

It should also be recognized that some environmental damage may have only a small impact on societal well-being.

4.4 The economic costs of environmental mitigation and pollution reduction

In order to reduce the potential environmental impacts of mining, deep sea mineral extractors will likely be compelled to follow the industry's Code for Environmental Management of Marine Mining (IMMS 2011). Governments and the International Seabed Authority will require that the mining company and its partner organizations undertake steps to mitigate and reduce environmental impacts. For instance, a recent publication by the International Seabed Authority (Van Dover *et al* 2011) on the environmental management of deep sea chemosynthetic ecosystems put forward guidelines (the Dinard Guidelines) aimed at protecting the natural diversity, ecosystem structure, function, and resilience of chemosynthetic ecosystems, while enabling rational use. While efforts to reduce environmental impacts may result in savings by avoiding losses in ecosystem services, many such environmental protection activities represent real economic costs that must also be considered in weighing the potential value of deep sea mining.

Macroeconomic impacts of deep sea mining

The potential economic benefits and costs of deep sea mining affect the overall level of wealth injected into a country. At the same time, the generation of market values (revenues and financial costs) can be expected to create knock-on effects throughout the economy.

Revenue generated from deep sea minerals could allow national governments to provide services previously out of financial reach, such as new hospitals, schools, or roads. In so doing, local engineering firms, contracted to do the work, might be expected to employ new staff. These workers would then have money to buy food and pay for housing in the community. With increased sales revenue and housing costs, local businesses might experience a small boom, and they in turn might take on additional staff who would buy more products.

In this way, the market benefits of deep sea mining (earnings and investment) can spread throughout the national economy.

However, not all economic impacts of deep sea mining are likely to be beneficial. First, macro-economic ripple effects generated from deep sea mining will only be sustainable for as long as the national benefits of deep sea mining exceed the national costs. Even industries running at a loss can maintain employment and support local shops and service industries while money is pumped into them. However, income pumped into failing industries will be deflected from other industries where national benefits might be higher than costs and where positive ripple effects could be generated without support. As a result, continuing investment in the sector, if deep sea mining is unprofitable, would likely occur at the expense of other areas of the economy. Further, where national costs exceed benefits, the industry represents a drain on national resources, and sooner or later the money will run out. At this point, rather than supporting sections of the economy, these sections would suffer negative ripple effects, contracting, shrinking, and potentially closing.

In contrast, where the national benefits of deep sea mining exceed their costs, new wealth is created in the economy, and the associated macro-economic growth can be sustainable – depending on how it is used and its investment in social and economic capital, as indicated earlier.

4.5 Weighing the benefits and costs of deep sea mining

Pacific Island states will need to make decisions about whether the potential benefits of deep sea mining, both within their national jurisdictions and beyond, exceed the costs. When, for example, might revenues be sufficient that some level of environmental damage would be acceptable? And what is the threshold for acceptable versus unacceptable levels of environmental damage?

Even a full accounting of costs and benefits might not tell policy makers in the Pacific whether deep sea mining is in the best interests of the state or region. It is critical to understand which costs and benefits will be felt by the Pacific Island states and which will be enjoyed abroad. Methods are needed to compare the potential costs and benefits of deep sea mining – to weigh the costs and benefits outlined above, but also to assess these impacts in the context of other societal, cultural, and development goals.

4.5.1 Benefit-cost analysis

Benefit-cost analysis is now a requirement of most major development projects. It is a framework used to assess the economic merits of an activity from the perspective of society. It involves:

- calculating the gains and losses (benefits and costs) from an activity to the community (or state), using money as a measure; and
- aggregating values of gains and losses and expressing them as net economic value (benefits less costs) (Pearce and Turner 1990).

In benefit-cost analysis, costs and benefits are organized both by year and over time to determine the aggregate economic impact of a project. This impact is represented in terms of net present value, which places greater weight on costs and benefits generated in the present than in the future, or internal rates of return, which show the relative proportion of benefits compared to costs (Figure 4.6).

Traditionally, benefit-cost analysis has focused on the direct financial costs and benefits of a project, adjusted to account for taxes, subsidies, and other market distortions. More recently, the approach has been expanded to include opportunity costs, including environmental costs, like those discussed earlier in this chapter (see *Pricing Nature* by Hanley and Barbier (2009)). Including opportunity costs provides a more complete accounting of the combined direct and indirect (external) costs and benefits – those that are reflected in the market and those that are not. Indirect and non-market estimates of costs and benefits, however, are not always easy to quantify, and the estimates used in a benefit-cost analysis may reflect this imprecision.

Benefit-cost analysis can also be used to show how the costs and benefits of a project are distributed across different businesses, organizations, individuals, or communities. This is known as distributional analysis. A distributional analysis is likely to be especially useful when designing programs to reinvest mining taxes/fees/royalties in social capital or when trying to identify stakeholder groups that are likely to support or challenge deep sea mining plans.

Figure 4.6 Benefit-cost analysis.

Benefit-cost analysis, however, does not provide a direct comparison between economic considerations and other social, political, or cultural goals or considerations. Other mechanisms, such as multi-criteria analysis, strategic environmental impact assessment, or life cycle thinking, may offer a better way of weighing the societal impacts of deep sea mining.

4.5.2 Multi-criteria analysis

Multi-criteria analysis is a decision-making tool that allows for the comparison of a variety of impact measures – economic, social, cultural, political, and biological – associated with a proposed project. This approach can be useful in a situation such as deep sea mining, where a complete economic accounting of project impacts on ecosystems and people might not be feasible.

4.5.3 Life cycle thinking

Life cycle thinking provides an important lens through which to view potential impacts throughout the life of a process – from the extraction of resources to the production of final goods and services (known as a “cradle to grave” approach). The impacts considered by life cycle thinking include those that occur locally, nationally, regionally, and globally.

As applied to deep sea mining, a life cycle approach would include impacts associated with exploration, commissioning, extraction, transport and processing, entry to market, integration in production of products, consumption of final products, and end of life, including reuse or redesign of mining infrastructure, as well as of products in which the minerals are utilized, when possible.

Toolbox for life cycle thinking

Life cycle assessment: a technical tool designed to apply the concepts of life cycle thinking to the potential environmental impacts of a product or service. The criteria for a life cycle assessment are defined through the ISO 14040 series.

Social life cycle assessment: an assessment of the social implications or potential impacts of a good or service.

Life cycle costing: the sum of all economic costs over the full life cycle (or a specified period) of a good or service. This can include the costs of purchase, installation, operation, and maintenance, and estimated value at the end of its defined life cycle. (ISO 15600 series)

Design for the environment: an analysis of three main design objectives: design for environmental processing and manufacturing; design for environmental packaging; and design for disposal or reuse. (Multiple ISO standards cover this approach, contingent on application.)

Eco-labelling: a communications tool to help consumers and businesses make more informed decisions. (Four main categories of labels and their associated criteria are defined through the ISO 14020 series.)

Source: UNEP and SETAC (2011) http://lcinitiative.unep.fr/, UNEP (2009) Guidelines for Social Life Cycle Assessment of Products, CIRAIG (2011) http://www.ciraig.org, ISO (2012) www.iso.org

4.5.4 Strategic environmental assessments

Perhaps the most comprehensive tool to weigh deep sea mining’s contribution to broader national development and environmental goals is the strategic environmental assessment. Strategic environmental assessment is a tool designed to achieve sustainable development by promoting dialogue, mutual understanding, and trust among stakeholders from the grass roots to high-level decision-makers. Unlike environmental impact assessment, strategic environmental assessment does not focus on one specified activity at one site, but takes a broader industry/marine space-wide approach (see Figure 4.7 for further comparison). The strategic environmental assessment process aims to ensure that the policies and national plans underpinning the development of extractive sectors take other users of land, sea, air, water, and other shared environmental assets into account within a coherent national development agenda. Strategic environmental assessment would be part of a transparent process, with the aim of ensuring that all stakeholders – governments, civil society, and the private sector – are involved in the planning of deep sea mining.

Strategic environmental assessment has been used in industrialized countries for years to provide a frame of reference for the development of national and regional plans and programs (Figure 4.8). It has gained support from governments and civil society groups in the Pacific (DEAT 2007), as well as from such development partners as the World Bank and the Organisation for Economic Co-operation and Development (OECD) (Kjörven and Lindhjem 2002; OECD 2006). In the European Union, strategic environmental assessment has become a legally enforced procedure required by Directive 2001/42/EC, which aims to ensure systematic assessment of the environmental effects of strategic land-use-related plans and programs.

Difference between EIA and SEA

Environmental Impact Assessment of projects	Strategic Environmental Assessment of strategic initiatives
A Technical instrument related to activities with geographic and technical specifications	A Political instrument related to concepts
A Reactive approach - at the end of the decision-making process	A Proactive approach - at earlier stages of the decision-making process
Identifies specific impacts in the environment	Addresses issues of sustainable development
Limited review of cumulative effects	Gives early warning of cumulative effects
Emphasis on mitigating and minimizing impacts	Prevention in terms of identified environmental objectives

Least strategic → Most strategic

Most detailed ← Least detailed

GRID-Arendal

Figure 4.7 Environmental impact assessment (EIA) and strategic environmental assessment (SEA) as part of a decision-making process.

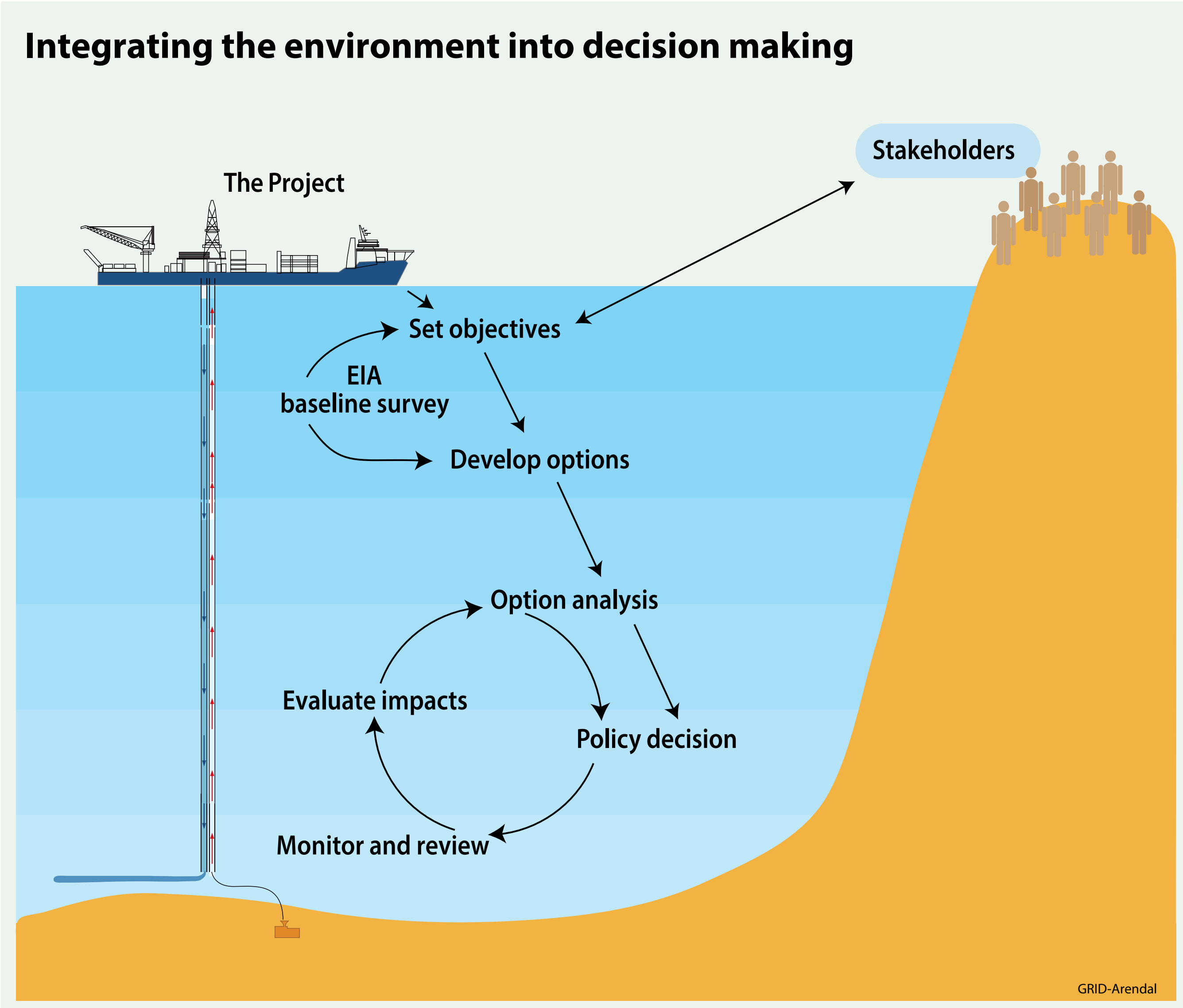


Figure 4.8 Integrating the environment into decision making using SEA.

4.6 The political economy of deep sea mining

Deep sea mining is technologically, politically, and legally complicated. It is an evolving and extremely costly endeavour. As a result, the economic decisions associated with deep sea mining are intertwined with political factors and other economic considerations that are only indirectly related to a proposed mining project. For instance, international aid, diplomatic concerns, or other political factors may be important elements in whether or not a country decides to grant a concession to a foreign corporation. In the Area, state contracts or sponsorship may have as much to do with the strategic importance of access to minerals as they do with the potential profitability of a mining operation.

4.7 Deep sea mining as one of a portfolio of options to reach development goals

Deep sea mining is just one of many possible economic options that Pacific Island states can utilize to meet development goals. Too much dependence on one or a narrow selection of development opportunities exposes a country to economic risks beyond its control.

Other options for green economic development include:
- traditional economic activities, such as artisanal fishing, crafts, and farming;
- greened manufacturing and service sectors;
- reformed commercial fisheries (especially through policies that capture more of the fisheries' value for use by the state or communities);
- green tourism; and
- payments for the ecosystem services produced by healthy reefs, mangroves, and terrestrial habitats.

To ensure that this portfolio of options meets development needs equitably and sustainably, it is important to consider how new development options, such as deep sea mining, affect other existing and potential options.

Ecological, economic, and social resilience are important considerations when weighing the costs and benefits of deep sea mining, as well as the potential ways in which the proceeds of mining might be reinvested in society.

Tools and analyses – such as benefit-cost analysis, multi-criteria analysis, life cycle thinking, and strategic environmental impact assessments – can help Pacific Island states understand the potential impacts of deep sea mining. These tools can help identify opportunities to make deep sea mining an important part of a green economy.

Key messages

A decision by a state to proceed with deep sea mining requires careful assessments of the broad range of economic and social consequences that could result, and analysis showing that the overall benefits to the country are greater than the potential costs associated with mining.

When feasible, action should be taken to minimize the environmental impacts of deep sea mining, provided that the benefits exceed the costs of doing so.

A green economy can be achieved if an equitable portion of the economic proceeds of deep sea mining are reinvested into other forms of economic, social, and natural capital to ensure that societal well-being is improved and made more sustainable and resilient.

Fishing in Vanuatu. Photo courtesy of Ransom Riggs

Vanuatu market. Photo courtesy of Ransom Riggs

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5.0 Anticipating Social and Community Impacts of Deep Sea Mining

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Other chapters in this volume demonstrate that the mineral extraction potential of deep sea mining could be enormous, that economic opportunities are driving Pacific Island states' exploration of deep sea mining, and that deep sea mining – if approached from a holistic environmental perspective – might offer Pacific Island states economic means of achieving development goals. But what of the social and community impacts of deep sea mining? How might communities be affected or societies changed when the most socially disruptive aspects of mining shift offshore? How can such impacts be predicted, measured, and monitored? And will communities be able to register complaints successfully, exercise decision-making authority, or grant a social licence to operate to an industry operating not in their backyards, but in their equally prized and culturally important seas?

Discussion in this chapter is based on several key assumptions:

- that many of the common socio-cultural and socio-environmental concerns linked to terrestrial mining will also be relevant to deep sea mining, although perhaps to differing degrees;
- that deep sea mining, like onshore operations, will be subject to regulation that requires consideration, reporting, and redress of social impacts and formally lodged community complaints; and
- that the risks and negative impacts Pacific Island communities perceive as being associated with deep sea mining are just as important as the actual risks.

Finally, it is acknowledged that the term community is problematic, as it may appear to conflate or ignore existing diversity, divergences, hierarchies, and power relations (Banks 2002). Keeping this complexity in mind, the term is used here for ease of discussion.

Current knowledge suggests that deep sea mining will not directly impact local communities to the same degree as terrestrial mining. The central question then becomes: how significant is the impact from deep sea mining likely to be? The answer will lie, in part, with when and how issues are assessed and changes identified. At this early stage, all parties must focus on how anticipated or identified impacts are to be addressed and create processes that involve local communities in determining whether the balance between benefit and impact is satisfactory (Gibson 2000).

5.1 The usual case for mining: economic and development imperatives

Mining is frequently associated with negative social and environmental impacts on communities and environments. Nevertheless, strong cases are made for the continuation and expansion of the mining industry, even in places where mining has previously resulted in social or environmental catastrophes. Besides the dependence of contemporary civilization on mined products, perhaps the most common argument in support of terrestrial mining is its historical position as a lucrative industry. As a new industry, the extent to which deep sea mining can deliver similar (or any) economic benefits is yet to be determined.

In the case of onshore mining, economic benefits usually flow to government in the form of taxes and royalties paid at a local and national level. In certain situations in Pacific Island states, such as on Lihir Island in Papua New Guinea, compensation payments to the local community also comprise a significant part of economic benefits (Bainton 2010). Such funds can have extraordinary effects on local and national infrastructure, amenities, and services, especially in developing nations. Economic gains from mining have the potential to fund community development, to boost education access and quality, and to improve health and healthcare services. Compensation payments, when invested well, can improve livelihoods, build small, local businesses, and generate greater community wealth. Other substantial economic benefits of mining may include, but are not limited to, employment, local procurement, downstream processing, investment in infrastructure, and local business opportunities (Esteves and Vanclay 2009).

Mining-company-funded corporate social responsibility programs are also increasingly common, with the major multinational miners distributing hundreds of millions of dollars each year. A range of voluntary initiatives specific to mining or its primary products also shapes companies' approaches to social responsibility. Such frameworks include the influential Global Reporting Initiative's *Mining and metals sector supplement* (GRI 2010), the United Nations Global Compact, and the International Council for Mining and Metals. Other initiatives aim to encourage responsible mining practices through supply chain pressure. EARTHWORKS' "No dirty gold" campaign, for example, targets jewellery companies, asking them to agree to source gold that is mined in an ethical manner, aligned with the initiative's 10 Golden Rules (EARTHWORKS 2010).

However, and importantly, mining's economic benefits are not all benign. A growing number of studies suggests a negative relationship between mining and economic indicators of development (Davis and Tilton 2005). Some economics writers now recognize that local communities often bear the brunt of negative social impacts while the rents realised by the country flow elsewhere (Davis and Tilton 2005). Especially in countries where corruption is rife or in which strong financial governance or business ethics are lacking, mining-derived wealth can be a curse for local communities (Auty 1993). Monies intended to support social initiatives, improved infrastructure, or health campaigns can end up in the pockets of individual leaders, and mining companies may be complicit in these exchanges, either wittingly or unwittingly. Legislation, such as the recent Dodd-Frank Act in the United States, and mechanisms, such as the voluntary Extractive Industries Transparency Initiative (EITI), can counteract financial corruption and help to ensure that mining profits reach intended beneficiaries. Much work remains to be done, however, before local communities in many developing countries reap the benefits of extracted resources. Even where strong regulation is in place, the economics of mining require close examination and planning to ensure that mining benefits host countries, regions, and communities, and to identify and address the social costs of mining.

5.2 Common social impacts of mining

Predicting the impacts of mining on society is a complicated task (Vanclay and Esteves 2011) that will differ from site to site and will depend upon a range of factors, including project scale, point of project life cycle, location, associated industries, economic benefits and benefit distribution, cultural norms and expectations, project alternatives and opportunity costs, related environmental impacts, regulation, and the perspectives or philosophies of both the commissioning company and the assessor.

Understanding and addressing social impacts is further complicated by the fact that mining and other resource developments are often polarizing, both for those impacted and for those assessing the impacts. There is an emerging, but still limited, move away from traditional, tick-the-box assessment (Nish and Bice 2012) towards more community-focused approaches, creating space for community voices and frequently involving long-term, in-depth community engagement. This approach can offer insights and opportunities unavailable through one-off engagements by academics or impact assessment practitioners.

The social impacts commonly identified with terrestrial mining operations can be organized into the 11 research-tested categories listed in Figure 5.1 (Bice 2011). Impacts can be both positive (such as socio-economic development or provision of healthcare) or negative (such as loss of land access or conflict).

Current proposals for seabed mining in the Pacific Islands region appear to involve little or no onshore presence, and so the direct social impacts may well differ from those that have been seen with terrestrial mining projects. However, as deep sea mining exploration and development proceed, it will be important for all parties involved to create an environment open to investigation and reporting. This environment will enable continuous prediction and assessment of benefits and negative impacts to ensure that related plans – including impact assessment and mitigation, community relations plans, and closure/rehabilitation plans – take into account the considerable range of issues that may be associated with mining projects.

Communities learning about deep sea mining. Photo courtesy of Nautilus Minerals.

Economy, employment, and work practices	Those impacts that can be directly related to the mine, involving changed economic and employment circumstances that subsequently affect other aspects of social life, such as direct employment, contracting, wages, and housing affordability. Includes issues related to shift and fly-in/fly-out (FIFO) work.
Family and home life	Includes changes to family structures, traditional family practices, living arrangements, and impacts on local housing and accommodation (e.g., availability).
Community identity	Those impacts that cause changes in the ways in which community members understand their culture, practices, intrasocial relationships, and unique community characteristics.
Insiders and outsiders	Those effects that result from the introduction of new people (often via FIFO workforces) into communities that are relatively isolated (geographically or culturally), and the changes that occur amongst community members as a result.
Land use, ownership, and access	Those impacts that occur across the mine life cycle, from exploration to rehabilitation, including community engagement and other interactions that consider issues of ownership, and can result in land use agreements, or that dictate how land is accessed and used. Water use agreements and access to bodies of water must be considered with deep sea mining.
Gender and human rights	Those impacts that may have distinct ramifications for women or for gender roles in the community. Impacts that may influence the ability of individuals within the community to realize their human rights, as defined under the UN Universal Declaration.
Indigenous populations	Considers a range of effects that have unique and material impacts on the livelihoods, status, rights, roles, and situations of indigenous or tribal people.
Community health	Includes impacts related to diseases/illnesses that may affect both the local community and the mine's operations. Includes impacts of disease that might be introduced by mining operations (e.g., sexually transmitted infections) and healthcare initiatives (e.g., mining-company-funded malaria eradication program).
Infrastructure, services, and social amenity	Considers pressures and changes related to increased population and traffic, including service provision, social amenity (e.g., parks, gardens, community space) and infrastructure.
Socio-environmental	Includes social impacts related to environmental concerns, such as noise, dust, chemical use, and water pollution.
Conflict and protest	Includes any violent interactions, protests, or armed conflicts that are directly or indirectly related to the mine's presence or operations. Also includes non-violent protest linked to mining or mining-related issues.

5.2.1 Social changes commonly associated with terrestrial mining

It is vital to acknowledge that with mining comes change. This is especially the case where there has been little development before, or where mining has the potential to dominate economic, political, cultural, or social life. Figure 5.2 summarizes the types of change commonly associated with onshore mining projects (Franks 2011) and categorizes these changes according to the social impact categories defined in Figure 5.1. Impacts and changes brought by deep sea mining may differ from the historical experience with terrestrial mining and will not be felt by all stakeholders or felt at the same time. Considering Figure 5.2, for example, it appears that the impacts listed under Community Identity, Infrastructure, Services and Social Amenity, Insiders and Outsiders, Community Health, and Family and Home Life will be less applicable for deep sea mining than for terrestrial mining.

Type of Change / Areas Affected	Social Impact Category/Risks, Benefits
Political, Social, and Cultural Change	
Insiders and outsiders	
Population and demographics	In-migration, out-migration, workers' camps, social inclusion, growth or decline of towns, conflict and tensions between social groups
Crime and social order	Corruption, domestic violence, sexual violence, substance abuse and trafficking, prostitution, change in social norms, pace of change for vulnerable communities
Community identity, family and home life	
Culture and customs	Change in traditional family roles, changing production and employment base, effects of cash economy, reduced participation in civil society, community cohesion, sense of place, community leadership, cultural heritage
Infrasucture, services, and social amenity	
Social infrastructure and services	Demands on and investment in housing, skills (shortages and staff retention), childcare, health, education, and training
Community health	
Community health and safety	Disease, vehicle accidents, spills, alcohol and substance abuse, pollution, interruption to to traditional food supply, awareness and treatment programs
Economy, employment, and work practices	
Labour practices	Health and safety, working conditions, remuneration, right to assemble, representation in unions, labour force participation for women
Employment and competition	
Political	Pacific Island state government focus and resources on deep sea mining, opportunity cost for other development options
Confllict, gender, and human rights	
Human rights and security	States overriding community self-determination, suppression of opposition and demonstrations, targeting of activists, rights awareness programs
Gender and vulnerablegroups	Disproportionate experience of impact and marginalization of vulnerable groups (e.g., women,disabled, aged, ethnicminorities, indigenous, and young), equity in participation and employment
Economic Change	
Economy, employment, and work practices	
Distribution of benefits	Employment, flow of profits, royalties and taxes, training, local business spending, community development and social programs, compensation, managing expectations, equitable distribution across state/regional/local/ethnic/family groups, cash economy
Industry	Change in industry composition, dominance by foreign entities in a high-tech industry
Family and home life	
Inflation/deflation	Housing (ownership and rents), food, access to social services
Infrastructure, services, and social amenity	
Infrastructure	Demands on and investment in ports, power, communications, and related infrastructure

Type of Change / Areas Affected	Social Impact Category/Risks, Benefits
Socio-Environmental Change	
Socio-environmental	
Pollution and amenity	Terrestrial, coastal (port and transport), surface (spills and transport), and deep-water (associated with mining activity) pollution
Community identity	
Resettlement	Consent and consultation for resettlement, compensation, ties to land, adequacy of resettlement housing and facilities, equity, post-settlement conditions, livelihoods
Disturbance	Disruption to economic and social activities (including by exploration), consultation for access, frequency and timing, compensation
Land use, ownership, and access	
Resources (access/ competition)	Marine resources, subsistence fishing, cultural practices, scarce infrastructure
The Process of Change	
Community engagement	Consultation, communication, participation, empowerment, access to decision-makers, transparency, timing, inclusiveness (particularly for vulnerable and marginalized groups), respect for customs and authority structures, reporting
Consent	Cultural use of terrestrial and marine areas (free, prior, and informed consent), community consent
Participation	Planning, development of programs, monitoring, selection of alternatives and technologies, operational aspects
Remedy	Grievance and dispute resolution, acknowledgment of issues, compensation, mitigation
Agreements	Equity, timely honouring of commitments, issues with delivery, duress, clarity of obligations, capacity, and governance (including government capacity to respond to and manage change)
Community development	Participation, adequacy, appropriateness, capacity to facilitate, consistency, prioritization

Figure 5.2 Common changes induced by mining activities that can lead to social impacts and risks, adapted from Franks (2011) and Bice (2011).

A life cycle approach to deep sea mining's social impacts

The deep sea mining life cycle is potentially a long one, in which the early phases – marine research, exploration, feasibility studies, and fund raising – have already been in progress for decades in certain areas. Figure 5.3, below, outlines three key phases of the life cycle and shows that social impacts and changes may apply to all phases in varying degrees and to different stakeholder groups, at household, local, regional, national, and international scales (Hajkowicz *et al* 2011).

Although deep sea mining is in the early phases of development, it is important to be aware of issues related to scales of impact. These issues are frequently controversial, as local communities may disagree with national or regional governments about such concerns as customary usage, cultural rights, ownership, and authority. The concerns become even more complex in a marine environment, where ownership may be unclear or vary depending on exact seabed location, and may also be subject to traditional, national, and international norms, laws, and agreements. Here, the network of interested or potentially impacted stakeholder communities expands to include other coastal communities, national governments, neighbouring states, researchers, industry, and civil society. With deep sea mining, even where there are no identified resource owners or communities suffering direct impact, the minerals are located in areas than many consider part of a global commons. As such, these resources may be viewed as national property in which every citizen has an interest, further complicating processes of consultation, usage, and ownership. The uncertainty of these boundaries will likely make it difficult to define and agree upon who the impacted communities are.

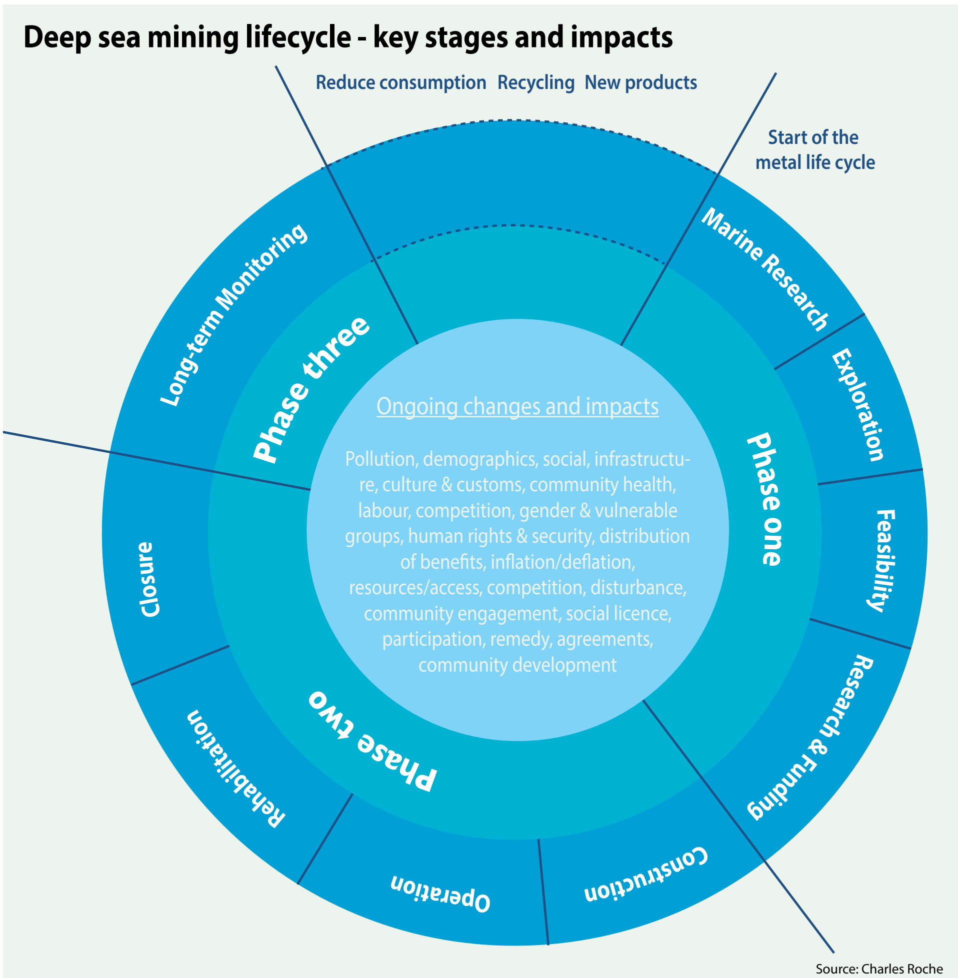


Figure 5.3 Deep sea mining life cycle

Valuing community perceptions of risk

The depth, breadth, likelihood, and potential severity of the social impacts of deep sea mining are as yet unknown, and proposals to mitigate environmental impacts remain untested. It is this very lack of experience and data related to the impacts of deep sea mining that is perhaps the biggest concern for communities. Moreover, a general lack of public understanding about the deep seabed and its ecosystems (Littleboy and Boughen 2007; Boughen *et al* 2010) means that misinformation has appeared in public debate and fears abound. Research suggests that the risks community members perceive as being associated with a particular sector or operation may be as important in their impact on the community as the actual risks supported by scientific data (Haines 2011). For the communities fearing such risks, the stresses are real and inform their responses to industry and practice.

Communities' perceptions of risks and impacts are greatly informed by prior experiences and knowledge of terrestrial mining operations. It is, therefore, helpful to review the history of terrestrial mining in Pacific Island states. This survey (Section 5.3) provides a foundation for analysis of relevant deep sea mining impacts later in the chapter.

Mixed Community, Lau Ridge. Photo courtesy Chuck Fisher.

5.3 Pacific Island states' experiences of terrestrial mining

Papua New Guinea, Kiribati, Nauru, and New Caledonia have historically had greater exposure to mining than other Pacific Island states, and their histories colour understanding of and approaches to future mining (Filer and Macintyre 2006). Past relationships between mining companies and Pacific Island communities have been characterized by extraordinary complexities, interdependencies, tensions, and contradictions. If the lessons of the past are to inform the future, it is crucial that such factors inform decisions about deep sea mining.

Mining in the Pacific Islands has earned a notorious reputation over the years. Operations like Ok Tedi, Panguna, Bougainville, and Freeport (West Papua) evoke images of environmental damage, community disputes, and legal wrangling. While there is considerable debate about the causes (Banks and Ballard 1997; King 1997; Hyndman 2001; Banks 2002; Filer and Macintyre 2006), it is clear that there is a complicated and interconnected relationship among mining, the environment, and social impacts.

5.3.1 Lessons for offshore mining from onshore mining

The complexities of historical terrestrial mining impacts show that predicting and mitigating impacts of a new deep sea mineral industry will require a whole-of-system or ecological approach (Banks 2002). Using such an approach, researchers,

Some impacts of mining in Papua New Guinea

Many of the most visible and damaging impacts related to terrestrial mining have been socio-environmental impacts related to water, especially in Papua New Guinea. There, riverine tailings disposal has had devastating effects on traditional lifestyles, relations to land and water, and sustainable livelihoods (Banks 2002). River pollution has led to conflicts between communities and raises important questions about which stakeholders must be considered and included in mining company planning, consultations, and decision making.

In Papua New Guinea, downstream communities were historically not included in consultations. Later, however, they became those most affected by mining operations (Banks 2002). At Papua New Guinea sites, such as Lihir, where riverine tailings disposal was not used, submarine tailings disposal – encompassing all aquatic disposal of tailings – has affected traditional fishing practices and caused local alarm (Macintyre and Foale 2004). Even where scientific studies have shown submarine tailings disposal to be within specifications, locals remain concerned about sediment plumes and their effects on fish and the health of the marine environment (Macintyre and Foale 2004).

Social impacts related to community identity have also played a major role in the experiences of onshore mining in Pacific Island states. Community concerns about environmental degradation associated with mining are frequently in conflict with strong, collective desires for development (Filer and Macintyre 2006). Especially in Papua New Guinea, an almost spiritual desire for development has arisen since the 1970s (Macintyre and Foale 2004), with the communities of Lihir seeing development as their destiny (Bainton 2010). Beyond material goods, monetary wealth, and access to quality schools and healthcare, development may take on mythical proportions (Macintyre and Foale 2004). The Maimafu of Papua New Guinea, for example, recount visions of a golden man spreading wealth across their lands, while Lihirians envisage a destiny in which Lihir becomes the New York of the Pacific (Bainton 2010).

Desires for development and socio-cultural hopes for wealth and improved livelihoods have been known to outweigh environmental concerns. Even at Ok Tedi, site of perhaps the most infamous environmental catastrophe, certain communities have called for further exploration and mining development in hopes of achieving the wealth and status associated with mining (Filer and Macintyre 2006). Where Pacific Island communities or governments express support for deep sea mining, such positions should be understood within a cultural context that often prizes idealized notions of development, at times above other significant impacts.

companies, communities, and governments situate responses to mining within social, political, cultural, and economic contexts (Banks and Ballard 1997).

Deep sea mining developers can learn from terrestrial experiences, which demonstrate that legal limits and scientific benchmarks may not be aligned with community expectations and standards. Even where scientific evidence to support a mining practice is available, communities may approach such data with suspicion or even outright disbelief.

Social changes may, in fact, be largely indirect and are likely to be political, with Pacific Island governments' focus on deep sea mining limiting opportunities for alternative developments and industries. Economically, issues related to the distribution of benefits from deep sea mining are probable, especially with regard to flow of profits, royalties, and taxes. Concerns are also likely to arise regarding compensation and equitable distribution of economic gains across Pacific Island societies. The growth of the deep sea mining industry signals a change in Pacific Island industry composition, with consequent concerns about foreign ownership in a high tech industry.

The history of Pacific Island states' experiences with terrestrial mining suggests that socio-environmental concerns related to pollution and environmental amenity will be especially important. These might include issues linked to the use of coastlines (such as for ports, transport, or mooring of mining-related ships and equipment) and any deep-water pollution or disturbance associated with mining activity.

Issues related to land use, ownership, and access will be highly relevant to deep sea mining. Concerns may be raised about subsistence or other local fishing operations or disruption of cultural practices.

Government institutions will be fundamental to the process, as will their competence to acknowledge and regulate negative social impacts of mining and their willingness to balance environmental preservation against economic gain.

Negative long-term outcomes are not the result of poor governance alone. Corporate governance and genuine commitment to corporate social responsibility and transparency are also vital to getting the balance right. Effective institutions, governance, and even constitutions (Andersen and Aslaksen 2008) are essential if a balance is to be achieved between impacts and benefits, and it is critical that such mechanisms are established before the deep sea mining industry develops further.

Pacific Island leaders and commercial operators have the opportunity to establish a new marine mining industry that is steeped in the hard lessons learnt from terrestrial mining, that values genuine corporate responsibility and sustainable development, and that includes communities in informed decision-making processes.

5.4 Early Pacific Island state responses to deep sea mining

While responses to deep sea mining are coloured by experiences with terrestrial mining, the new offshore sector has been approached enthusiastically by Pacific Island governments. Support is evidenced by media reports and participants' and official responses at events such as the 2012 SPC-EU Deep Sea Mineral Project meetings (McClean 2011; Tawake 2012). Communities appear less convinced, but, with little independent research into the views of Pacific Islanders on deep sea mining, this perspective is difficult to assess. Important questions about the impacts and perceived risks of deep sea mining remain, and appear to shape community concerns. Certainly, anecdotal evidence (including recent examples from the Cook Islands and Papua New Guinea) indicates the same tensions identified with onshore mining – between potential environmental degradation and likely economic gain, and between social harm and economic development – also shape the current deep sea mining debate.

Cook Islands

The Cook Islands government is an enthusiastic supporter of deep sea mining. Scientific surveys suggest the sea floor within the islands' Exclusive Economic Zone (EEZ) is rich with manganese nodules (Lynch 2011). At the time of writing, the Cook Islands is also the most legislatively-prepared nation among Pacific Island states. In 2009, the legislature passed the Seabed Minerals Act (Cook Islands 2009). Subsequently, a natural resources advisor was hired to assist in the development of the industry in the Cook Islands EEZ (Parnis 2012). A Seabed Minerals Authority, led by a Seabed Minerals Commissioner, has been set up, and an advisory board of community representatives has been appointed. These initiatives represent a significant investment in deep sea mining and demonstrate legislative and regulatory leadership.

The draft planning documents released thus far (Cook Islands Government 2012) and the announcement of a one-million-square-kilometre marine park provide a strong indication that the government of the Cook Islands is committed to implementing principles of corporate social responsibility, community participation, environmental protection, and prudent financial management.

This approach is matched by the positioning of its political leaders. In March 2012, the Minister for Minerals and Natural Resources, the Hon. Tom Masters, outlined a "wide and proactive approach" to deep sea mining consultations. Stakeholder consultations in 2011 incorporated traditional leaders, non-governmental organizations, and churches, with further and more comprehensive consultations planned (Masters 2012). While it appears that such consultations may have been aimed at encouraging positive community sentiment towards deep sea mining, research suggests that public attitudes remain hopeful but cautious, with a large part of the population viewing deep sea mining negatively (Lynch 2011).

The Te Ipukarea Society, an environmental non-governmental organization and a member of the International Union for Conservation of Nature (IUCN), is representative of such concerns. For example, in September 2010, the Te Ipukarea Society warned against seabed mining on Radio New Zealand International. In March 2012, the Society identified a series of concerns about deep sea mining in its newsletter, including sustainability, research, sedimentation, and processing (Cook Islands News 2012). Motion M-105 (IUCN 2012), sponsored with the Agence des Aires Marines Protégées and co-sponsored by 20 other organizations, was submitted to the September 2012 World Conservation Congress. The Motion identified a range of concerns noted in previous IUCN resolutions and called for:

- research into impacts of deep sea mining on biodiversity;
- establishment of protected areas prior to mining;
- strategic environmental assessment;
- environmental, social, and cultural baseline and impact studies; and
- the application of an ecosystem-based precautionary approach to deep sea mining.

The motion and related issues mark an important step by a civil society group to formalize community concerns about deep sea mining on a global scale.

While government legislation and activities like those of Te Ipukarea – before any licence for seabed mineral activity (even exploration) has been granted within Cook Islands' waters – indicate a precautionary approach to deep sea mining in the Cook Islands, concerted social scientific research is needed to understand the extent and character of public sentiment towards deep sea mining.

Papua New Guinea

The situation in Papua New Guinea is more advanced and complex than in the Cook Islands. In 2011, Nautilus Minerals Inc., a Canadian-owned company, received the first mining lease to explore massive sea-floor sulphide deposits at the Solwara 1 site, located in Papua New Guinea's internal waters between New Britain and New Ireland provinces (Nautilus Minerals 2013b). Exploration drilling has occurred since 2007, with project commencement originally slated for 2013. At the time of writing, however, Nautilus had put its sea-floor production system on hold due to an unresolved dispute with the Papua New Guinea government concerning project development costs (Nautilus Minerals 2012). Even with the project on hold, deep sea mining in Papua New Guinea represents the most advanced stage of development of this industry in any country.

Despite this relatively advanced stage of exploration, independent social scientific research is lacking. One independent review of Nautilus Minerals' stakeholder consultations, conducted as part of the requirements for the project's environmental impact statement, is publicly available (Coffey Information Systems 2008). Nautilus Minerals held stakeholder consultations at many sites or villages – some repeatedly – through its

Community meeting, Dyual Island, Papua New Guinea. Photo courtesy of Charles Roche

Nautilus CARES corporate responsibility program, and it reports that more than 5000 people were consulted (Nautilus Minerals 2013a). Nautilus has also set a new standard for transparency in Paua New Guinea in relation to the public release and availability of scientific studies, adding significantly to our understanding of the natural environment.

Despite Nautilus's consultation process and scientific transparency, criticism of the project appears to be growing, especially through social media. Mainstream media coverage, private and public Facebook pages (for example, http://www.facebook.com/deepseaminingpacific), the Stop Ocean Crime Now Twitter account (https://twitter.com/NoDeepSeaMining), and issue-specific web pages (such as http://www.deepseaminingoutofourdepth.org/), all reflect growing public concern about deep sea mining.

Without scientific studies, it is impossible to quantify or reliably articulate the volume, specifics, or intensity of Papua New Guinea community views regarding deep sea mining, let alone the views of international observers and stakeholders. Yet a growing online and media presence indicates strong community interest. Such concerns are further reflected in high community attendance at Nautilus's consultations (Coffey Information Systems 2008) and the formation of community activist groups, such as The DSM Campaign, with international campaign partners that include Oxfam Australia, Mining Watch Canada, and Friends of the Earth Australia (DSMC 2013).

The collective action of the Bismarck-Solomon Sea Indigenous Peoples Council (BSSIPC) further illustrates the concerns of Papua New Guineans about deep sea mining. BSSIPC formed in 2008, following a meeting of 80 people from five different Papua New Guinea provinces, representing a number of different areas and community groups (Shaffner 2008). While BSSIPC does not represent all affected communities, its breadth of membership suggests that its position, aiming to represent the environmental and sustainability concerns of coastal indigenous peoples regarding the exploitation of the Bismarck-Solomon Sea region (Figure 5.4), may be reflective of diverse communities from throughout the country (Steiner 2009). For example, BSSIPC asserted indigenous peoples' rights to free, prior, and informed consent over deep sea mining through its Karkum National Seabed Mining Forum Statement of 2008 (MPI 2008). BSSIPC also presented at the Madang Conference in 2008, made a submission to the Mining Wardens court hearing for Solwara 1 in March 2009, and commissioned an independent review of the Solwara 1 environmental impact statement by the council's science advisor.

The Karkum Statement (MPI 2008) presented a clear articulation of the many concerns the community has about the potential impact of deep sea mining. The statement identifies the lack of protection and conservation for the Bismarck-Solomon Seas area and details concerns regarding inadequate research, consultation, legislation, regulation, assessment, and monitoring of the proposal. Through the statement, BSSIPC claimed rights under customary law, the Papua New Guinea constitution, the principle of free, prior, and informed consent, and the UN Declaration on the Rights of Indigenous Peoples. In affirming their rights to protect and benefit from the area, BSSIPC specifically withheld consent for any deep sea mining in the Bismarck and Solomon Seas.

The BSSIPC, supported by an independent review of the environmental impact statement, recommended the formation of a citizens' advisory council to represent the views of impacted communities and to enable effective engagement and consultation (Steiner 2009). This recommendation has not been taken up by the Papua New Guinea government or Nautilus.

As these brief examples reveal, Pacific Island states' perceptions of deep sea mining appear divided to date, with great variance between government and community stakeholders. Although targeted social science research would be required for a more accurate interpretation, evidence suggests a great deal of tension around the deep sea mining industry's "social licence to operate".

Figure 5.4 Bismarck-Solomon Sea region.

5.5 A social licence to operate and free, prior, and informed consent

The push to employ deep sea mining to contribute to economic development in the Pacific is occurring at the same time as rights-based reform is slowly gathering momentum in the international mining industry. The International Finance Corporation's *Environmental and Social Sustainability Performance Standards*, for example, recognize the need to include marine aquatic resources within assessments as important ecosystem services for local people (IFC 2012). If any resource venture is to gain the support of communities in the Pacific, it will require a process that supports the right to community self-determination at multiple scales. Such considerations are increasingly being incorporated into international frameworks guiding environmental and social sustainability. (An example is the recent EU-SPC DSM Project workshop on Public Participation and Social Impacts, Vanuatu 2013; see also SPC (2012) *Regional Legislative and Regulatory Framework*.) Specifically, concepts of a social licence to operate and obtaining free, prior, and informed consent from resource owners or indigenous peoples directly impacted, offer important approaches to ensuring stakeholders are properly consulted and participate in decisions that affect their communities and environments.

5.5.1 Social licence to operate

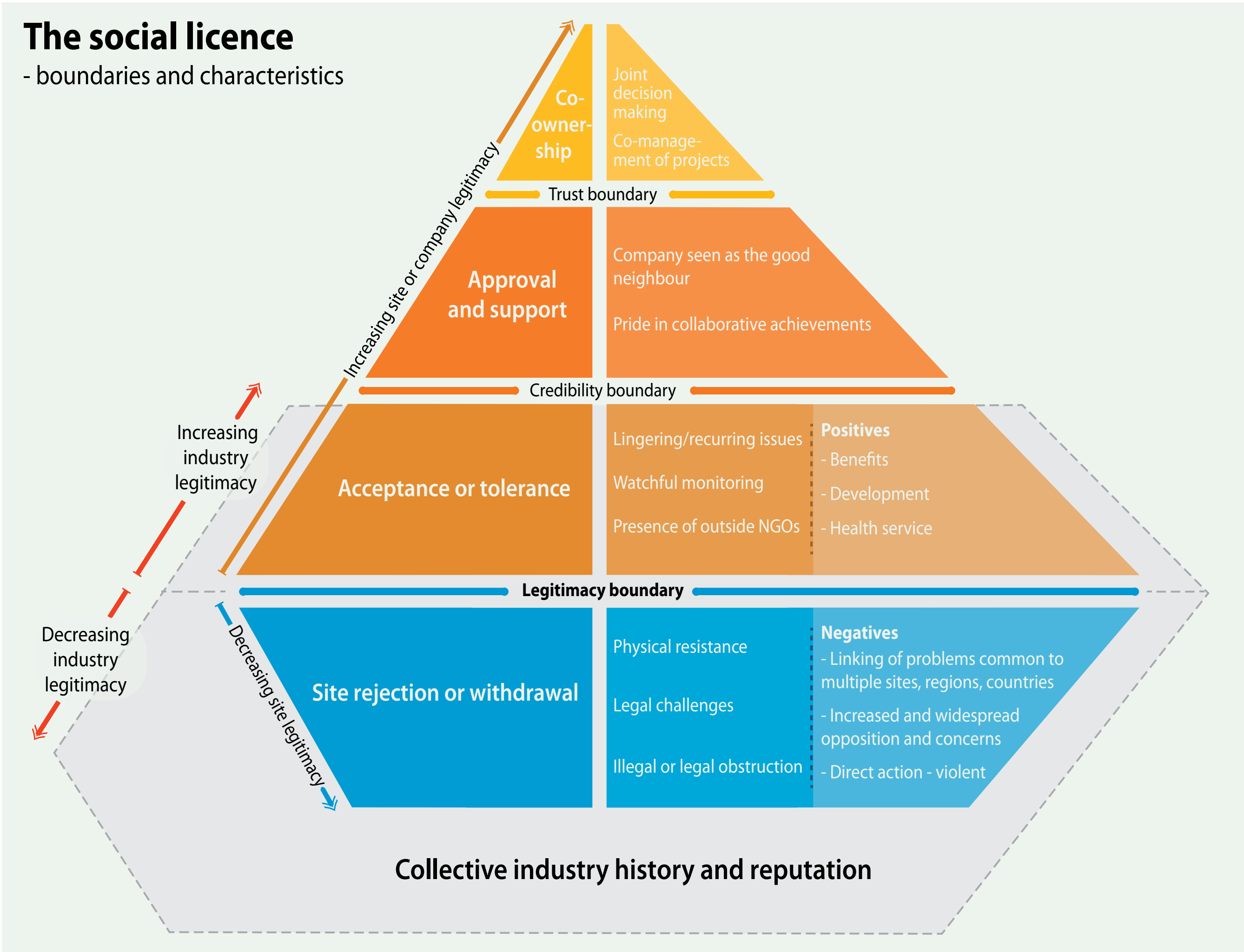
In recent years, mining companies and affected communities have invoked a social licence to operate (that is, ongoing approval for a project from the local community and other stakeholders) as a means of representing the importance of identifying and addressing onshore mining's social impacts and consequent social changes (Joyce and Thomson 2000). Indeed, the loss of a social licence has been ranked among the major risks for mining operations in recent years (E&Y 2012). Despite its widespread usage in the mining industry, the social licence to operate remains a fiercely debated concept (Joyce and Thomson 2000). Some scholars have begun to raise important questions about its utility for communities and the differentiation between approval, a lower standard of acceptance, or even resignation (Owen and Kemp 2012). Nevertheless, it remains widely employed, and certain communities are also adopting the concept as a means of asserting authority in relation to mining developments. Although it is a voluntary and informal construct, such widespread usage supports discussion of the social licence to operate as a relevant and potentially powerful model in relation to deep sea mining.

Current studies suggest the social licence is closely related to notions of social capital: that is, the levels of trust, listening, and promise keeping between key parties affected by resource extraction (Thomson and Boutilier 2011). Although it remains unclear exactly how a social licence is granted, there appears to be general agreement among researchers, mining companies, and communities that a social licence must be earned and maintained by the mining company through attention to legitimacy, credibility, and trust (Prno and Slocombe 2012). Social licence requirements run the gamut from worker safety to cultural sensitivity, and the degree of social licence proffered by a community may range from withheld/withdrawn through to assimilation of a firm within the community fabric (Figure 5.5).
Experiences to date suggest that the following issues will affect the deep sea mining industry's social licence in the Pacific:

- marine oil and gas extraction;
- management of Pacific fisheries;
- governance standards;
- transparency and corruption;
- targeted minerals;
- processing and waste disposal; and
- community interest/action and engagement.

Given the experience and existing concerns in the Pacific, it is likely that any deep sea mining development will be significantly impacted by existing views, thus affecting the industry's or individual operator's ability to gain and maintain a social licence. While further research is required, potential proponents of deep sea mining will have to overcome a range of factors if the industry and individual projects are to achieve a social licence to operate in the Pacific.

Earning and maintaining a social licence is a dynamic process, requiring negotiations about impacts and benefits to communities throughout the life cycle of the mining project. There is no single approach that facilitates a social licence. Rather, each site and community requires unique engagements that foster continuing, mutually beneficial relationships. For example, studies concerning a potential deep sea mining industry for Australia define a



Source: After Boutilier 2009 and 2012

Figure 5.5 Model of a social licence to operate: levels granted by community.

social licence for deep sea mining as comprising two central components. First, the benefits of any deep sea mining operation must outweigh the potential short-term and long-term negative impacts. Second, stakeholders must have trust in the systems and regulations established to monitor and control the deep sea mining industry to ensure that the information they receive is accurate, comprehensive, and unbiased, and that community interests will be prioritized as the industry develops (Boughen *et al* 2010). Regardless of the location of deep sea mining activities, communities benefit through being involved in decisions about their future, while industry benefits from increased community support for approved operations, which can reduce business risk from social impacts (Herz *et al* 2007; Herbertson *et al* 2009).

5.5.2 Free, prior, and informed consent

The notion of free, prior, and informed consent is often discussed alongside, or as a prerequisite to, obtaining a social licence to operate in relation to terrestrial mining, where resource owners are identified or indigenous people's land or property will be affected by government and mining company decisions and actions. While definitions vary, consent incorporates a right of veto, and the main components of free, prior, and informed consent include community consultations that are free from coercion or pressure by any company or state and that ensure equal participation by women and minority groups (Hill *et al* 2010). For free, prior, and informed consent to be realized, such consultations must occur before any major decision about a project by government or industry and before any impacts on environment or community (Rumler 2011). In order for consent to be informed, affected people must have access to all relevant information. This requires mining proponents and government to be transparent in all interactions and to present both positive and negative potential impacts. Project alternatives must also be considered and presented. Information must be presented in appropriate, easy-to-understand language and be informed by independent experts. The capacity of communities to participate in the decision-making process is also crucial to true free, prior, and informed consent. This includes the provision of uncontrolled funds to allow communities to secure independent advice, where necessary (Lehr and Smith 2010). Where all of the above happen in an open and inclusive way, free, prior, and informed consent may be possible. However, communities must retain the ability not only to grant consent, but to withhold it. This ability to accept or reject projects and any related outcomes should be supported in legislation (Bridge and Wong 2011). Figure 5.6, below, outlines the basic steps in the free, prior, and informed consent process.

In theory, free, prior, and informed consent presents a strong and inclusive approach to stakeholder relationships. It builds communities' capacity to make informed decisions and empowers community members with the right to refuse projects that they believe, based on objective evidence, will cause more harm than good. In practice, free, prior, and informed consent is much more difficult to realize. While a growing number of mining companies espouse free, prior, and informed consent ideals, very few companies institute the practice in its fullest sense. Instead, they lean towards free, prior, and informed "consultation", in which ideals of transparency and strong community engagement are upheld, but where the decision about whether a project proceeds rests outside of community control (MacKay 2004). A notable exception is the acceptance by Rio Tinto of Traditional Owner veto or power of consent over the development of the Jabiluka uranium site in the Northern Territory of Australia (Trebeck 2009).

Although widespread implementation of an idealized free, prior, and informed consent process has not yet been achieved, the concept has some support: it was recently incorporated within the 2007 UN Declaration on the Rights of Indigenous Peoples (UNDRIP: UNGA 2007). However, this is a non-binding instrument, which has been signed by only 3 of the 15 Pacific ACP states – and not Tonga, Fiji, or Papua New Guinea (or any other leading proponent of deep sea mining).

5.5.3 Application of free, prior, and informed consent to deep sea mining

For the right of free, prior, and informed consent to apply, it is generally accepted (IFC 2012) that the project in question will:

- involve the relocation of indigenous peoples;
- have impact on land or natural resources that are subject to traditional ownership or customary use;
- significantly impact cultural resources that are critical to the identity of indigenous peoples; or
- use cultural resources or practices for commercial gain.

Whether these factors will be found in relation to deep sea mining projects, particularly those occurring far offshore in a country's outer EEZ, remains to be seen.

5.5.4 Adopting and implementing social licence and free, prior, and informed consent for deep sea mining

The deep sea mining industry has an opportunity to pioneer approaches to community engagement that foster local understanding of projects, value two-way communication, and devolve certain decision-making powers and accountability to communities.

Such concepts present important approaches to respecting communities' self-determination, assisting governments and mining companies in identifying and addressing potential impacts, and providing greater certainty for all through a rigorous and inclusive consultative process. Pioneering actors in the deep sea mining industry, including Pacific Island governments, now have an opportunity to embed within legal and operating frameworks a more meaningful version of social licence to operate, to ensure that community concerns and meaningful consultations are an inherent component of industry practice and government decision making.

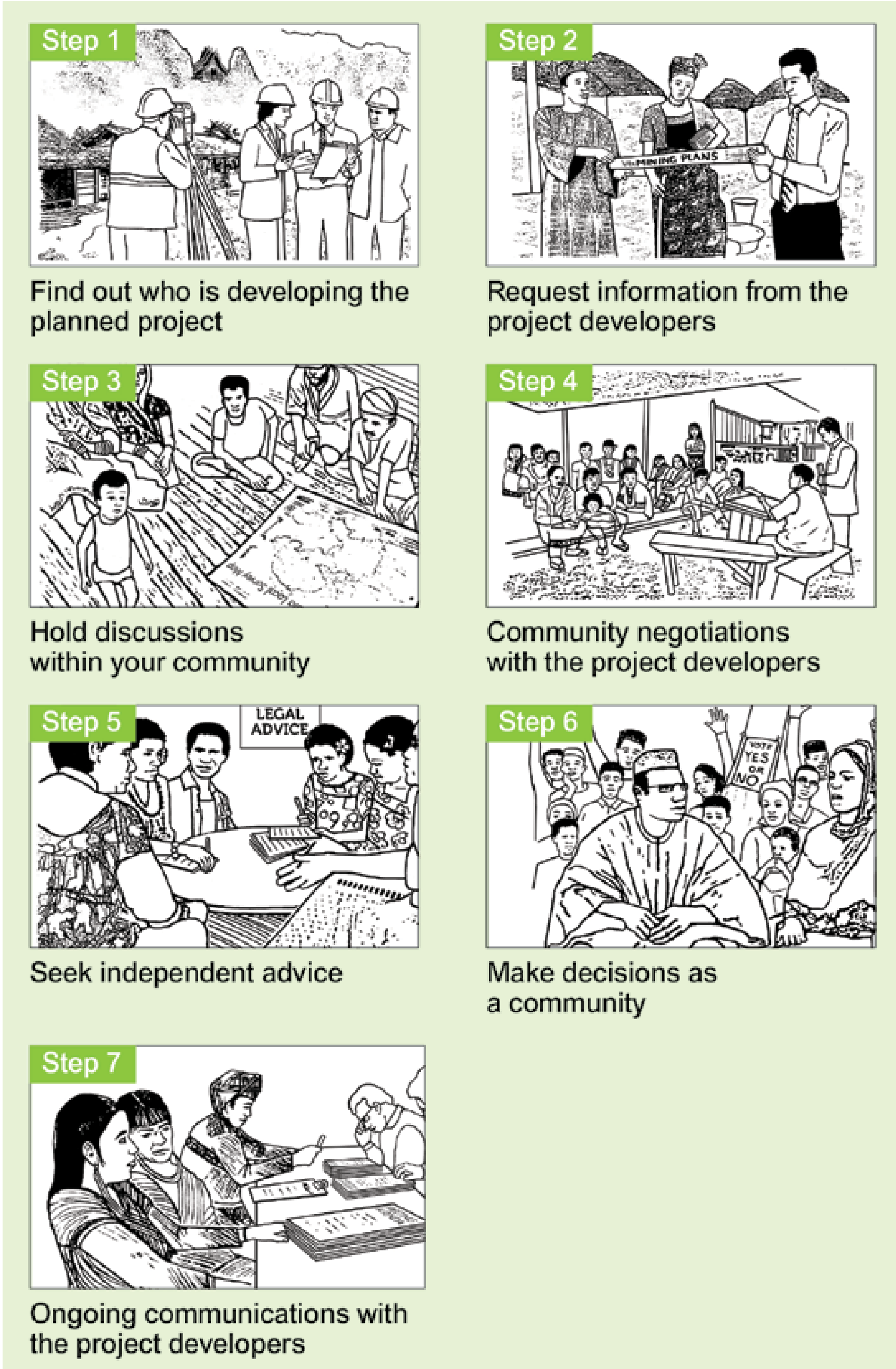


***Figure 5.6 Community guide to free, prior, and informed consent** (after Hill* et al *2010)*.

5.6 Conclusion: anticipating social impacts of deep sea mining

This chapter has explored research-identified social impacts and changes associated with on-shore mining to inform approaches to deep sea mining. The importance of addressing communities' perceived risks with the same seriousness as scientifically identified risks was highlighted, as was the need to accommodate the potential scales of impact associated with an industry where boundaries may be contested. The concepts of a social licence to operate and free, prior, and informed consent were introduced as vital components to a contemporary and holistic approach to deep sea mining's social impacts. Clearly defining the terms and conditions of the deep sea mining industry's social licence to operate and implementation of full-scale free, prior, and informed consent, in which communities are empowered with the ability to reject a project based on accurate and transparent information, are necessary steps to achieving best practice.

The social impacts most relevant to deep sea mining will likely be associated with several key social changes, presented below in no particular order. First, in relation to economy, employment and work practices, it is likely that changes linked to employment competition will come into play, especially related to potential competition for leading Pacific Island scientists and other related experts to join the deep sea mining industry, foregoing roles with Pacific Island government agencies or other industries. If Pacific Island governments' focus disproportionately on deep sea mining, this could also constrict the opportunity for the development of other industries. There may also be issues surrounding the distribution of benefits from deep sea mining, especially in relation to the flow of profits, royalties and taxes, and compensation and equitable distribution of economic gains across Pacific Island societies. The growth of the deep sea mining industry could signal a change in industry composition in Pacific Island states, with consequent concerns about foreign ownership in a high tech industry.

Secondly, in relation to human rights impacts, the deep sea mining industry will need to address issues of self-determination amidst a growing public awareness of rights. This can be achieved partly through effective and comprehensive implementation of social licence to operate and free, prior, and informed consent approaches.

Thirdly, the history of Pacific Island states' experiences with terrestrial mining suggests that socio-environmental impacts related to pollution and environmental amenity will be especially important to prioritize. This may include concerns linked to usage of coastlines (e.g., for ports, transport, or mooring of mining-related ships and equipment) and any deepwater pollution or disturbance associated with mining activity.

Finally, issues related to land use, ownership, and access will be highly relevant to deep sea mining. This may include use of and access to marine resources, implications for subsistence or other local fishing operations, disruption of cultural practices or damage to culturally important coastal or deep sea sites.

It is difficult to predict the timing, extent, or type of social impacts that will flow from development of deep sea mining in the Pacific. What is certain, however, is that where mining occurs, whether onshore or offshore, communities will be affected. The deep sea mining industry in the Pacific states stands at an unprecedented crossroads. Government and industry leaders have the opportunity to choose a mining industry which is steeped in the hard lessons learnt from terrestrial mining, which values genuine social responsibility and sustainable development, and which includes communities in informed decision-making processes. For deep sea mining companies, the alternative risks protests, drawn-out negotiations, loss of profits, and even conflict. For communities, the alternative risks a potentially irreversible loss of cultural heritage and environmental amenity. As the test case for deep sea mining globally, and in the face of such options, the deep sea mining industry in the Pacific holds great responsibility to model a new best practice for an emergent and potentially revolutionary industry.

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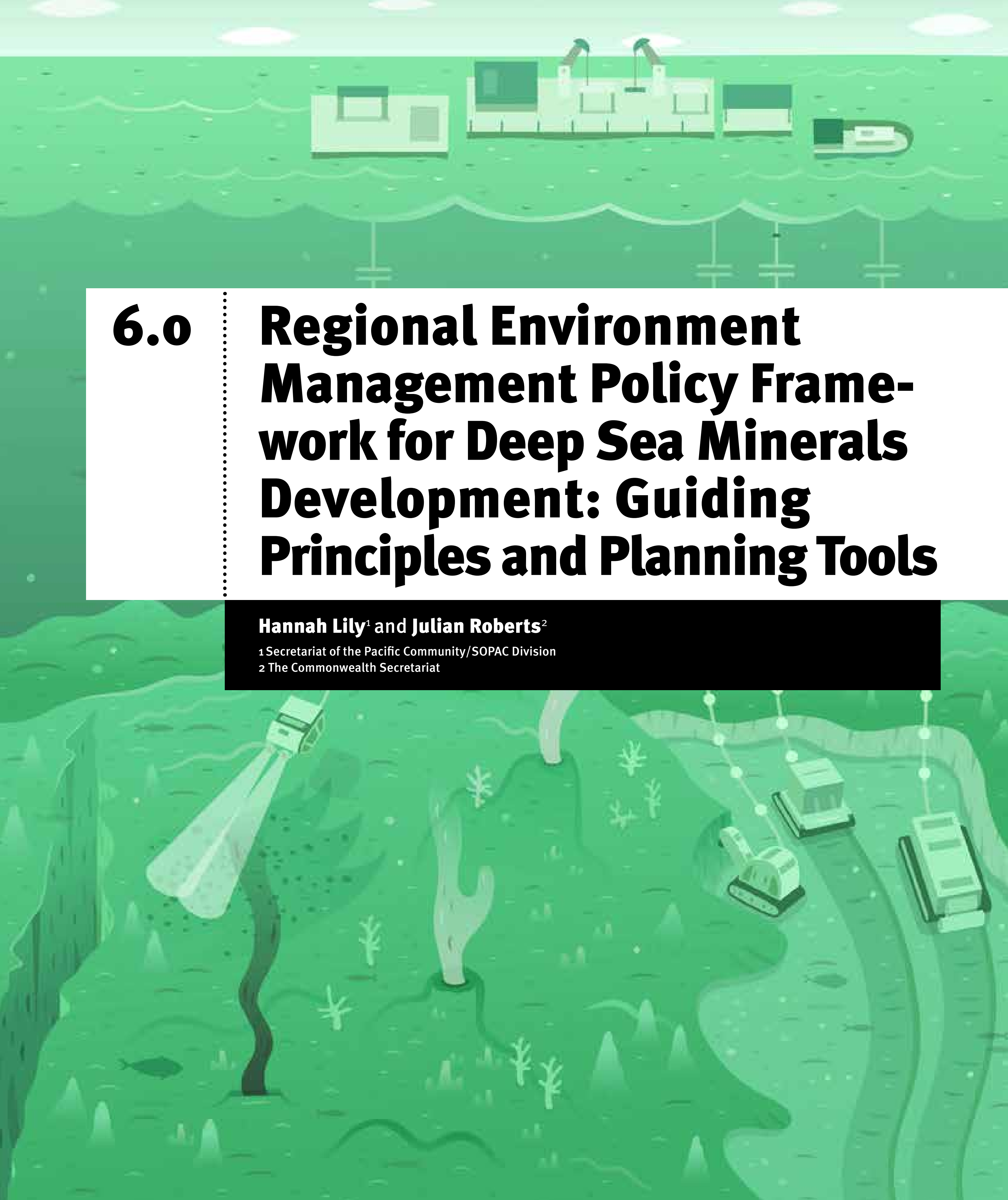

6.0 Regional Environment Management Policy Framework for Deep Sea Minerals Development: Guiding Principles and Planning Tools

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The international community has prioritized the importance of conservation and of the ocean and its living resources. International law requires states to ensure the marine environment is protected from seabed mining activities under national jurisdiction or control. However, national and international law and policies for conservation and environmental protection have not kept pace with plans for deep sea mineral exploration and extraction (Van Dover 2011). While the deep sea contains ecologically significant marine habitats that most nations have agreed to preserve, few, if any, states have put in place comprehensive policy and legislative frameworks to manage offshore mineral development in the deep ocean. The Pacific Islands region can therefore take a pioneering role in developing policy and regulatory regimes to manage deep sea mineral extraction (SOPAC 1999).

First, important policy decisions must be made, including whether to open the national jurisdiction for applications for deep seabed mining at all and, if so, how to allocate mining sites, to whom, and on what terms. Laws and regulations must be put in place to ensure that government retains appropriate control over activities in their jurisdiction or under their administration, and to enable private operators to understand the rules that will apply to them. In developing such a regulatory framework, numerous factors must be balanced. In addition to protecting the environment and ensuring the sustainable use of ocean resources as required under UNCLOS (1982), states will wish to maximize the economic potential of deep sea mineral resources, while not imposing unrealistic and unnecessary requirements that discourage investment or deplete any income generated.

An effective regulatory regime will therefore have multiple goals, including:

- to provide an enabling environment for industry to encourage investment and development;
- to manage the impacts on the environment and its biodiversity;
- to accommodate the interests of other marine users; and
- to secure sufficient benefits for, and minimize risks to, the state and its citizens.

A strong and clear environmental regulatory framework is likely to be well-regarded by potential investors in the deep sea mining industry, in particular when international financial institutions are involved. Increasingly, environmental issues are of interest to investors, and companies' environmental performances are linked to share prices. Regulatory clarity and consistency provide a more efficient operating environment for commercial actors.

The Pacific region is currently leading the way in exploring the different interests to be balanced and the international law requirements to be navigated in a national seabed mineral regime (SPC 2012; Figure 6.1).

6.1 International law

The development of legislation and regulations in the Pacific will occur within a well-established supranational legal framework. In particular, the 1982 United Nations Convention on the Law of the Sea (UNCLOS) sets high and mandatory standards for marine environmental protection when a state seeks to develop the marine resources in its exclusive economic zone (EEZ) or continental shelf. The obligation to comply with these standards applies regardless of the economic status or size of the state with control or jurisdiction over the activity, subject to the advice of the International Seabed Authority, contained in the 2011 ISA Advisory Opinion.

6.1.1 Obligations to protect the marine environment

The principal international law instrument governing the oceans is UNCLOS (see Chapter 2 for additional information), which establishes a comprehensive scheme for the use and development of the oceans.

In addition to the UNCLOS, there are a number of other relevant global and regional agreements, including the 1992 Convention on Biological Diversity (CBD: UN 1992b), the various regional agreements established under the UNEP Regional Seas Programme, the 1992 United Nations Conference on the Environment and Development and its action plan, Agenda 21 (UN 1992a). Of these, the CBD is especially relevant, as an international agreement that calls for conservation of all biodiversity. This obligation is to be implemented in the marine environment in a manner consistent with the rights and obligations of states under the UNCLOS.

The CBD adopts a holistic, ecosystem-based approach to the conservation and sustainable use of biological diversity and reaffirms the sovereignty of states over their own biological resources and their sovereign right to exploit these resources. The CBD imposes on State Parties a duty to identify and monitor potential adverse impacts on biodiversity and, specifically, to conduct environmental impact assessments of activities and processes under their jurisdiction or control with the potential for significant adverse impact on biodiversity. The CBD places great emphasis on in situ conservation, calling upon State Parties to adopt measures ranging from a system of protected areas to the rehabilitation of degraded ecosystems and the protection of natural habitats, as well as species conservation in natural surroundings (Van Dover 2011). In relation to areas beyond na-

Convention on Biological Diversity

The objectives of the Convention on Biological Diversity (CBD) include the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the use of genetic resources.

The CBD's provisions encompass all living organisms and their ecosystems.

The CBD contains a series of potentially far-reaching obligations related to the conservation of marine biodiversity.


SPC CPS

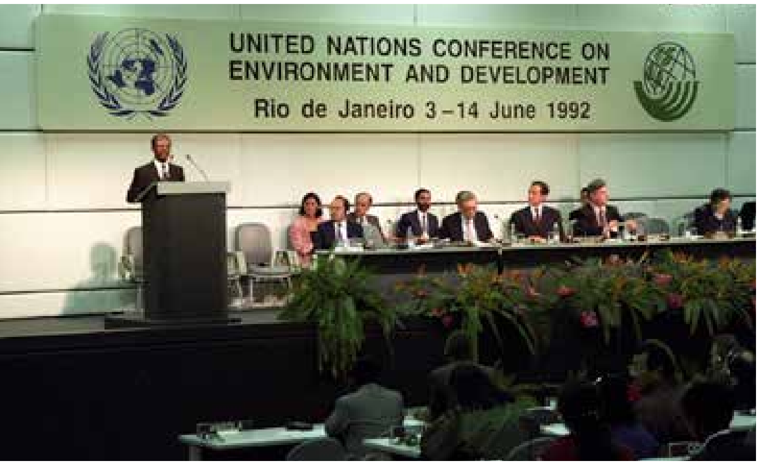
SECRETARIAT OF THE PACIFIC COMMUNITY

PACIFIC-ACP STATES REGIONAL LEGISLATIVE AND REGULATORY FRAMEWORK FOR DEEP SEA MINERALS EXPLORATION AND EXPLOITATION

Prepared under the SPC-EU EDF10 Deep Sea Minerals Project

July 2012

Figure 6.1 The report Pacific-ACP States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation was published by SPC in July 2012. It was prepared as part of the ongoing SPC-EU EDF10 Deep Sea Minerals Project.



United Nations Conference on Environment and Development. Rio de Janeiro, Brazil, 3 to 14 June 1992. Photo courtesy of United Nations News and Media.

Deep sea minerals meeting, Fiji, 2010. Photo courtesy of Virginia Rokoua.

tional jurisdiction, the CBD provides that "each State Party shall cooperate directly or through competent international organizations for the conservation and sustainable use of biological diversity" (UN 1992b: Art 5).

One of the outcomes of the 1992 United Nations Conference on the Environment and Development was Agenda 21 (UN 1992a), an ecosystem-approach-based action plan to promote sustainable development. Its key principles include:

- the precautionary approach;
- integrated management;
- the polluter/user-pays principle; and
- public participation.

Chapter 17 of Agenda 21 is devoted to the protection of the ocean, seas, and coastal areas, and the protection, rational use, and development of their living resources. It provides guidance on how to implement sustainable development and calls for a strengthening of international and regional cooperation to achieve this end.

The work of the UN General Assembly is also relevant in this regard. In 2006, the General Assembly passed Resolution 61/105, calling for action by states to ensure the protection of vulnerable marine ecosystems. Although the resolution specifically addresses the damaging effects of bottom fisheries, it has important implications for other forms of damage, including those expected to occur with deep sea mining. Hydrothermal vents, together with seamounts and cold-water corals, are cited as examples of vulnerable marine ecosystems, recognizing "the immense importance and value of deep sea ecosystems and the biodiversity they contain." (UNGA 2006:80) The UN Food and Agriculture Organization has identified five criteria for the definition of vulnerable marine ecosystems:

- uniqueness or rarity;
- functional significance of the habitat;
- fragility;
- life-history traits of component species that make recovery difficult; and
- structural complexity.

The resolution requires environmental impact assessments to be conducted for bottom fisheries by member states through regional fisheries management organizations and, where vulnerable marine ecosystems are known or likely to occur, requires conservation and management measures to be put in place to prevent significant adverse impacts to these features. As a result, several regional fisheries management organizations have already closed deep sea areas to prevent such impacts on fish populations.

Laws for deep sea mining within the Pacific Island region must also take into account obligations set out by specific regional conventions and ocean policy documents (such as the 2005 SPC *Pacific Islands Regional Ocean Policy*). A key instrument in this regard is the 1986 *Convention for the Protection of the Natural Resources and Environment of the South Pacific Region* (the Noumea Convention 1986). This is a legally binding agreement for the protection of the regional marine environment, which covers the combined EEZs of its Pacific region parties and the areas of the high seas completely enclosed by these EEZs. It recognizes that issues may arise in a transboundary context – since pollution does not respect political borders – and promotes a regional approach and inter-state collaboration.

The Noumea Convention

The Noumea Convention (Figure 6.2) requires Parties to protect and preserve the environment, to take all appropriate measures to prevent, reduce, and control pollution or other environmental damage of the Convention Area from any source, and to ensure sound environmental management and development of natural resources. It addresses pollution from seabed activities and requires Parties to protect and preserve rare or fragile ecosystems, depleted, threatened or endangered flora and fauna, and their habitat, including through the establishment of protected areas and the prohibition or regulation of any activity likely to have adverse effects. Parties are obliged to carry out environmental impact assessments, including public consultation, to assess and mitigate the potential negative impacts of major projects on the marine environment.

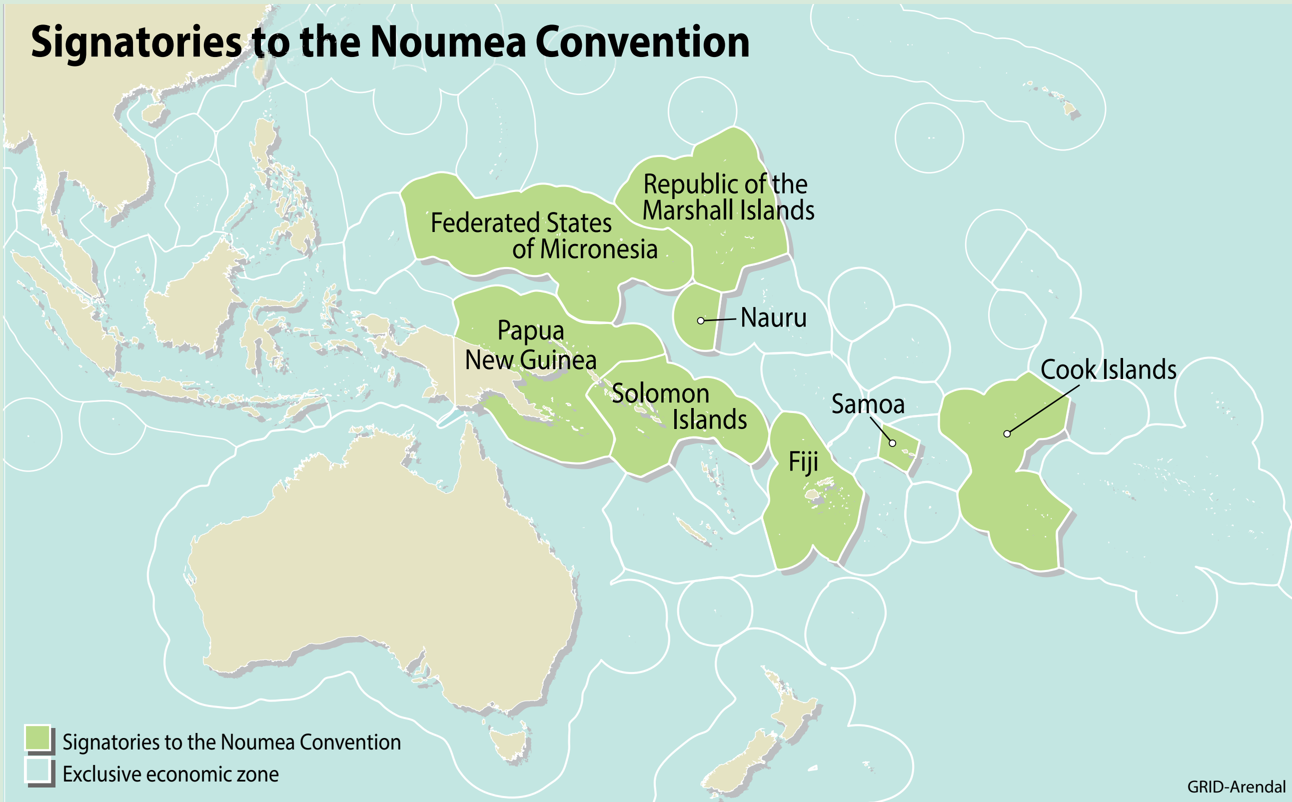


Figure 6.2 Signatories to the Noumea Convention.

6.2 Legislative requirements

6.2.1 Discharge of state obligations

Developing island states may be particularly well placed to access the potential benefits of deep sea mining, but they may not have the legal and technical expertise and financial capacity to execute deep seabed mining projects without the services of a foreign commercial (or industrialized state) mining company. Where mining activities will be performed by third party operators within a state's waters, or in the Area under the state's sponsorship, the state must take measures to secure compliance by the third parties with all applicable environmental standards – or risk state liability for any damage occurring as a result (UNCLOS 1982: Arts. 139, 235). However, if a government can show that it has taken the best possible steps to secure a contractor's effective compliance, it will be relieved of liability, even in the event of significant environmental damage caused by a compliance failure of an operator within the state's control or jurisdiction (UNCLOS 1982: Art. 139, Advisory Opinion paragraph 110).

A state will only be able to demonstrate that it has taken all reasonable measures to secure effective compliance by companies under its jurisdiction by establishing a robust national regulatory framework for deep seabed mining. Such a regime must be "no less effective than international rules" (UNCLOS 1982: Art. 208-209, Advisory Opinion paragraph 241), such as the ISA's Mining Code, and must require appropriate environmental protection measures of any operator licensed to conduct exploration or mining in the national waters. By enacting robust laws and regulations setting standards and introducing a monitoring and enforcement regime, states are able to mitigate with a high degree of certainty the potential risks and liabilities or costs arising from future seabed mining operations.

6.2.2 How to take adequate steps to ensure compliance with international law

National-level implementation of UNCLOS and other international obligations relating to deep sea mining will require:

- primary legislation (or statute) – to set the scope of the regime and the state's jurisdiction and regulatory powers, as well as the rights of individuals and prospective contractors;
- secondary legislation (or regulations) – to give more detail to the regime, perhaps by setting specific rules for different activities and/or deposits, including environmental assessment requirements; and
- administrative measures (licensing, monitoring. enforcement).

Contractual or licensing arrangements alone are insufficient (Advisory Opinion, paragraphs 223-226), and ideally the legislation should be in force before activities commence.

As a first step, government will need to determine how to allocate mining sites. States with no historic mineral experience may need to establish an in-country geological survey and cadastral mapping capability. They must decide whether the allocation will be done on a first-come first-served, staggered, or auction basis (an international tender process is generally recommended as an equitable and transparent system), and also which areas will be left as protected areas or reference sites. These decisions should preferably be made through an integrated marine spatial planning approach, taking into account all ocean users.

A regulating authority with responsibility for the management of seabed mineral licences will need to be established, or an existing entity designated and empowered to oversee the implementation of the new legislative regime and to exercise prescribed duties and functions.

Individual countries will have varying contexts and interests. They may consider tailoring their rules specifically to address certain aspects: mineral deposits, stages of mining activity, or location (particularly whether the proposed activities are in the state's archipelagic waters, territorial sea, EEZ, continental shelf, or in the Area), as standards and requirements vary according to differing impacts or risks.

In addition to ensuring compliance by third parties with its environmental protection obligations, each state's regulatory regime should also include provisions to ensure effective calculation and collection of income from mineral extraction (in the form of taxes and royalties) and equitable revenue investment and distribution of the benefits of deep sea mining to its citizens. Some approaches have been discussed in previous chapters. In addition, states might include in a legislative regime a program for assessment of, and compensation for, impacts of marine mineral development activities on commercial fisheries, shipping, traditional sea users, any landowners affected, and the nearest coastal communities.

The considerations set out in this chapter about environmental management and marine spatial planning, as well as some of the regulatory processes, will not be required for the sponsorship of a licensee in the Area, as the International Seabed Authority is administering the Area and will undertake these functions.

6.2.3 The attributes of an effective regulatory regime

Due diligence

Under International Seabed Authority rules in relation to the Area – standards that must be matched by laws governing national jurisdictions – appropriate checks and research must be conducted into the applicant and the proposed work plan before setting the terms of, and issuing, any licence for exploration activity. The degree of due diligence may vary according to the risks of the activity, which will depend on the location and site characteristics, the mineral, and the technology and research or extraction methodology to be used.

At the application stage for a project, the applicant should be required to provide evidence of the company's experience, expertise, and ability to perform mining activities in a timely, safe, and efficient manner. The evidence could be in the form of past project reports, company financial plans, a plan of work, proof of insurance, and guarantees. The quantity and detail of information required should be proportionate to the activity proposed and its likely impact.

The legislative regime may include a process for public notification about applications and decisions, and for participation by interested parties. Publication processes should balance the need for sufficient information and time for meaningful involvement by interested parties with the commercial sensitivity of the information.

An essential part of the due diligence process will be a requirement for the applicant to conduct (at its own cost) an environmental impact assessment before any mining or other activity entailing significant impact on the marine environment takes place (UNCLOS 1982: Art. 206, Advisory Opinion, paragraph 142f).

The incorporation of environmental impact assessment in legislation is still relatively new in most of the Pacific. Examples include the Tonga Environmental Impact Assessment Act 2003, Samoa Environmental Impact Assessment Regulations 2007, and Fiji Environment Management Act 2005. Consequently, the application of environmental impact assessment to development and resource planning is still in the early stages, and, anecdotally, its application has not always been consistent.

It is likely that new national environmental law for seabed minerals will be required (and reviewed as our knowledge increases) to set triggers for the conduct of environmental impact assessments and to incorporate public consultation processes as a legal requirement. A template developed during the joint SPC / ISA Technical Workshop in Fiji 2011 is useful in this regard (ISA 2011).

Cook Islands

The Cook Islands exclusive economic zone of almost 2 million square kilometres is believed to contain some 7.5 million metric tonnes of manganese nodules at a depth between 3 000 and 5 000 metres. It is a potential source of 32 million metric tonnes of cobalt, or 520 years' supply at current world demand. The Cook Islands government recognized at an early stage that seabed mining poses a very different set of challenges from land mining and requires new policies that maximize benefits to the people of the Cook Islands, safeguard the environment, allow public participation in licensing and policy decisions, and provide an environment conducive to foreign investment.

The establishment of modern and effective regulations to manage these resources has therefore been a priority issue, as the government seeks to expand, diversify, and enhance the nation's economy. To address this priority, the government developed the 2009 Seabed Minerals Act, a comprehensive legal framework for the development and management of the seabed minerals sector and a world first (Cook Islands Seabed Minerals Act 2009).

The Act and the forthcoming environmental and licensing regulations will provide the legal basis for the development and management of seabed minerals in a manner consistent with international law. A comprehensive management regime is being established for seabed mineral prospecting, exploration, and recovery activities. The intent of the Act is to serve as a robust regulatory framework that will facilitate the best development and management of the Cook Islands seabed minerals sector, with a focus on environmental impact assessment, corporate social responsibility, and transparency and accountability in all aspects of the development and management of the country's seabed mineral resources.

The outcome of the environmental impact assessment, which the government may wish to have verified by an independent expert, will be a crucial factor in the final decision as to whether mining can proceed and under what conditions.

The legislation should detail which decisions are open to judicial review, on what grounds, by whom, and by which court or decision-maker.

Compliance

The first step in the compliance function of a regulatory regime is to set out clear rules. For individual mining ventures, this can be done by way of an agreement and/or licence. This will be a legally binding and enforceable agreement between the state (as resource owner, managing the minerals on behalf of its citizens) and the licensee (the mining operator). The rules will place conditions on the activity and will be tailored to the individual work plan. It will include model terms that set standards that are non-negotiable and some terms tailored to the specific company and mining arrangement. Provision should be made for the review of compliance with the agreed terms within a given time frame following commencement of mining activities.

The terms of the licence will vary according to the activity proposed. Terms are likely to be more onerous for the exploitation of minerals than for prospecting and exploration activities, for example.

Acquiring a deep sea mineral exploration licence

What information might be required from an applicant for a deep seabed mineral exploration licence? The International Seabed Authority's Mining Regulations set out the following requirements for an exploration licence:

- information on financial and technical capability;
- proposed exploration program;
- detailed plan showing anticipated annual actual and direct expenditure on exploration;
- proposal for oceanographic and environmental baseline studies and preliminary environmental impact assessment;
- proposed measures to prevent pollution (contingency plan);
- undertaking of good faith;
- fee; and
- list of coordinates and chart of proposed area.

A licence for exploration may cover the following:

- operational parameters (such as size of mining area, duration of operation, retention and relinquishment rights and procedures);
- general performance standards (such as a timetable for activity or, where appropriate, commitment to adhere to international codes and standards, such as maritime law, the International Marine Minerals Society Code, Extractive Industries Transparency Initiative, or human rights law);
- standards and practices (including operational safety);
- an agreed environmental management plan;
- requirements relating to transfer of technical knowledge, capacity-building, or other participation of state nationals (including a requirement for a public complaints-handling mechanism);
- contractor baseline and ongoing data collection, and regular review and monitoring requirements;
- requirements for the contractor to report and submit data to the government;
- rules regarding access to and use of commercially sensitive data;
- conditions related to the winding down of mining activities, including provisions for site environmental reinstatement and remediation;
- guarantees and indemnities on the part of the licensee (for example, insurance, contingency plans, an undertaking to apply best environmental practices);
- financial arrangements (taxation, royalties, and fees);
- conflict avoidance or dispute resolution terms;
- penalties for breach of contract; and
- conditions under which the licence may be suspended or terminated, the notice period, and the processes.

In return for the operator accepting these obligations and giving the appropriate undertakings, the licence will give express rights for prescribed activities in the designated area. The rights might include security of tenure, exclusive exploration and access rights, preference over other applicants for exploitation of the same area, and title to the minerals extracted.

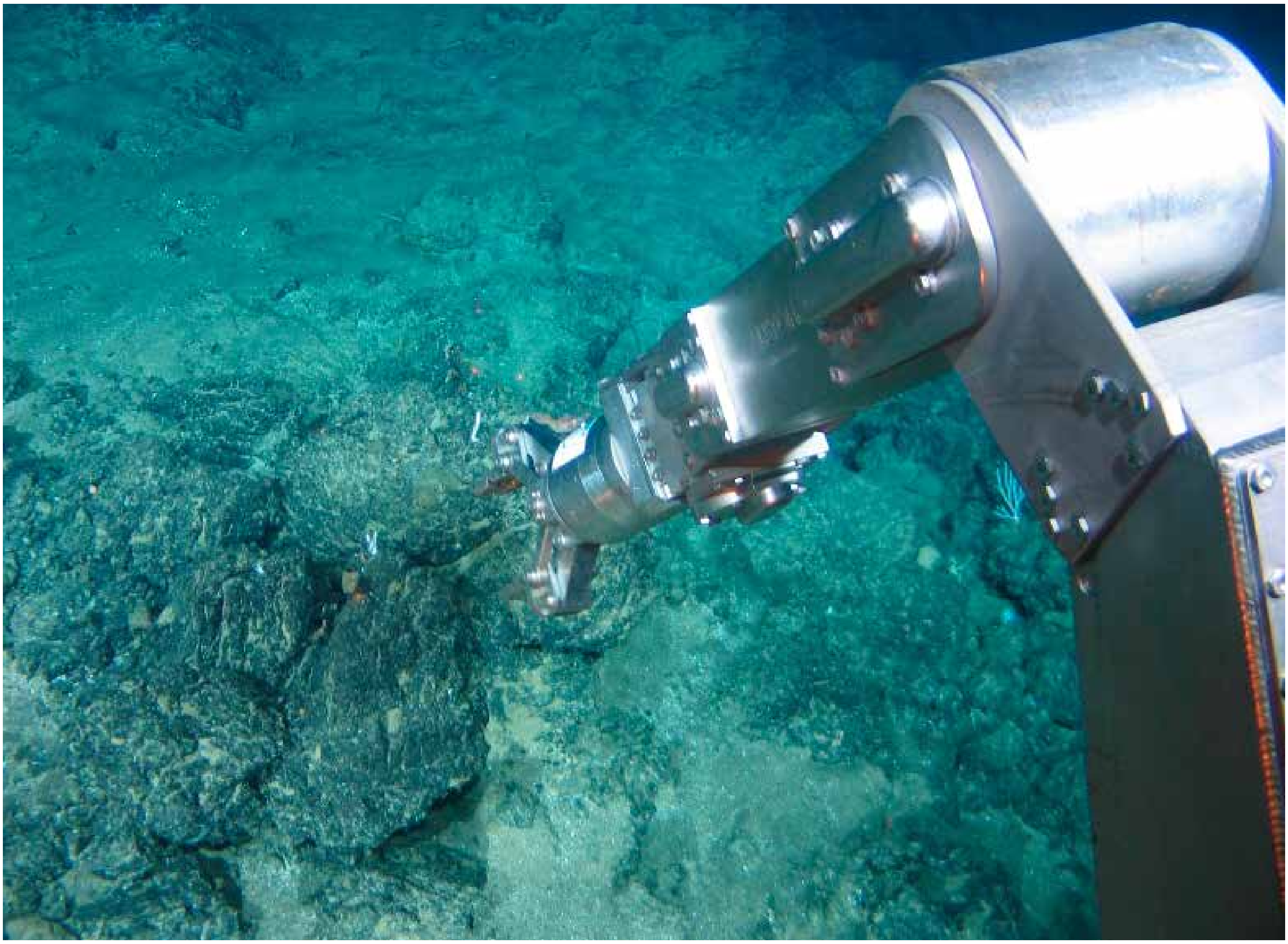
Monitoring and enforcement

Laws and regulations are not enough, on their own, to meet the UNCLOS environmental protection provisions. Monitoring and enforcement measures are also necessary ("the pulp mills case", International Court of Justice 2010: paragraph 197). Reporting requirements in the mining licence and agreement might include regular reports on progress, expenditure, and environmental issues, plus occasional reports when certain milestones or thresholds are reached or in the event that unforeseen incidents occur or new risks arise. The reporting requirements would include submission of baseline environmental data, against which activities and impacts can be assessed, as well as audited accounts. These reports should be reviewed carefully by the licensing authority (using independent experts, where appropriate) in order to be able to verify the program of work and its progress against the approved plan of work.

Publishing such reports – and thereby offering a mechanism for public or media response – can be an effective method of additional scrutiny, as well as an important step towards public accountability and transparency in the development of seabed minerals. These resources are, after all, effectively owned by the public. A government might also choose to combine self-reporting from the mining entity with other methods of oversight, such as site visits to inspect books and records, vessels and equipment, safety standards, and environmental monitoring.

For a regulatory system to work, there must be sanctions and penalties for non-compliance. A breach of laws or contractual terms or poor performance standards could trigger such penalties as suspension of the licence, termination, or amendment to particular aspects of the licence (for example, the area covered or the activities permitted). Financial penalties might also be imposed, or performance bonds forfeited. Regulatory action should be transparent and proportionate. The triggers and procedures for such actions should be set out clearly in the legislative regime and the individual licence and agreement.

There may be flexibility within the regime for minimal or risk-and-proportionality-based principles to apply in relation to minor or technical transgressions. Alternatively, notice periods could permit the contractor time to rectify any default. Other breaches that are more serious or pose immediate threats of harm may have strict liability and/or more robust repercussions. The regime might include criminal offences, and recourse should be available within legal systems for prompt and adequate compensation or other relief in the case of loss or damage caused by breach of the law or agreement on pollution of the marine environment.



Sampling sea-floor massive sulphides. Photo courtesy of Nautilus Minerals.

6.3 Guiding principles for sound environmental management policy

6.3.1 Good governance principles

A regional or national minerals policy will benefit from a foundation of good governance and management principles (Figure 6.3; UNEP 2007).

Our current lack of knowledge about many aspects of the oceans makes the adoption of the precautionary approach (UN 1992b) particularly relevant in developing management strategies for deep sea mining. The CBD and Agenda 21 acknowledge the need for precautionary, integrated and multi-level governance of marine ecosystems to help ensure that no activity is carried out that causes a long-term loss in biodiversity or irreversible environmental damage (Van Dover *et al* 2012).

The relationship between marine ecosystems and the environments that support them is intricate. Historically, marine and coastal resource management has been characterized by single-sector approaches, with jurisdiction falling to different levels of government. Integrated governance based on the ecosystem approach will be necessary in developing deep sea mineral policies. Ecosystem-based management seeks to consider, together, all uses and industries that affect an ecosystem, such as the deep sea.

Ecosystem-based oceans management strategies, laws, and regulation for deep sea mining would include provisions for:

- collecting adequate baseline information on the marine environment where mining could potentially occur;
- establishing protected areas where there are vulnerable marine ecosystems, ecologically or biologically significant areas, depleted, threatened, or endangered species, and representative examples of deep sea ecosystems; and
- adopting a precautionary approach that, in the absence of compelling evidence to the contrary, assumes deep sea mining will have adverse ecological impact and that proportionate precautions should be taken to minimize the risks.

Key governance principles for sustainability

Decision making	Democracy, subsidiarity; meaningful public and stakeholder participation; transparency; international cooperation; holistic approaches; policy coordination and integration; internalization of environmental and social costs
Precaution	Decision making under uncertainty, indeterminacy, irreversibility; adaptive approaches
Responsibility	Polluter pays; responsibility of generating knowledge; burden of proof; common but differentiated responsibilities; liability; accountability
Management	Prevention; rectification of pollution at source; adaptability; ecosystem approaches; partnership; mechanisms for regular review of the regime´s effectiveness and of the performance of the state institutions involved
Distribution	Intra-generational and inter-generational equity; capacity building

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Figure 6.3 Key governance principles for sustainability.

The development of a comprehensive system of spatial planning and area-based management is important to integrated governance of the marine environment. A number of spatial management tools may be usefully applied for this purpose.

Strategic environmental assessment (see also Chapter 4, paragraph 4.5.4 of this Volume) is a systematic process for evaluating the long-term environmental consequences of multiple actions within a region or ecosystem. The process should incorporate both environmental and socio-economic assessments and can involve habitat mapping, risk analysis, and sensitivity mapping. It provides decision-makers with information, strategies, and actual and projected information on environmental effects on a large scale, thereby allowing improved decision making and spatial planning of activities. In the context of seabed mining, strategic environmental assessment can help to integrate environmental issues more fully into the development of policies, planning, and program decisions. It can be used on a regional or national basis, especially prior to opening new areas to prospecting activities, but also for areas where activities are ongoing.

The precautionary approach

The precautionary approach is set out in the Rio Declaration on the Environment and Development, Principle 15, which states: *"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."* (UN 1992b: Principle 15).

This approach establishes international social responsibility to protect the public from harm where there is potential for significant harm to the environment and biodiversity, and states that lack of full scientific certainty is not an adequate reason for failing to act. This means that the burden of proof shifts, so that it is up to the contractor to prove that the proposed action would not be harmful. The provision that the precautionary approach shall be widely applied by states "according to their capabilities" means that proportionality, costs, and state capabilities are relevant considerations.

While the Rio Declaration is a non-binding legal instrument, through the operation of UNCLOS and the ISA's Mining Code, the precautionary approach is a mandatory requirement of international law for seabed mineral activities. How the precautionary approach will be manifested as the industry develops is yet to be seen, although its importance has been stressed by many commentators, including industry actors (SPC 2012).

Marine spatial planning maps which activities can be undertaken where, manages conflicts between competing marine activities, and reduces environmental impact by analysing current and anticipated uses of the ocean. It is a practical way to establish rational organization of the use of marine space and the interactions among its uses, to balance demands for development with the need to protect marine ecosystems, and to achieve social and economic objectives in an open and planned way. The principal output of marine spatial planning is a comprehensive spatial management plan for a marine area or ecosystem. Such a plan can help define priorities for the area and set out what those priorities mean in time and space. A marine spatial plan is usually implemented through a zoning map(s) and/or a permit system. In the context of seabed mining, individual decisions regarding prospecting, exploration, and production areas should be based on the zoning maps.

A marine protected area (or marine managed area or seabed protected area) can be defined as any area of the coastal zone or open ocean/deep seabed that has been accorded a level of protection for the purpose of managing the use of resources and ocean space or protecting vulnerable or threatened habitats and species (Kelleher 1999:107). Marine protected areas may be established for a wide range of purposes, including protecting marine species and habitats, conserving marine biodiversity, restoring fish stocks, managing tourism activities, and minimizing conflicts between resource users. The management of each marine protected area depends on the nature of the resources, their utilization, and the human activities occurring within them. The value of marine protected areas in relation to seabed mining is at least twofold:

- to set aside areas where no activity will take place, to act as a baseline for future monitoring of the impacts of exploration and production activities; and

- to ensure that representative areas of seabed habitat associated with the relevant seabed mineral resources and the associated biodiversity are protected from future impacts. This would also ensure their protection from other, non-mining activities.

6.3.2 Access to environmental information

Decisions related to deep sea mining must be taken on the basis of the best available scientific information. Effective governance requires factual information about the ecosystems, in particular their function, structure, state, and natural evolution (Figure 6.4).

Scientific knowledge should inform policy decisions about whether, when, and how exploration and exploitation of deep sea resources should be restricted or prohibited for conservation purposes. The following factors will assist a successful science-policy interface:

- mandatory preparation of environmental impact assessments, incorporating the latest scientific research and observation, for the exploitation of new areas and for all new exploration activities;
- results of scientific research translated and made accessible to policy makers and other users; and
- promotion at the outset of the role of scientific advice in informing policy and decision making.

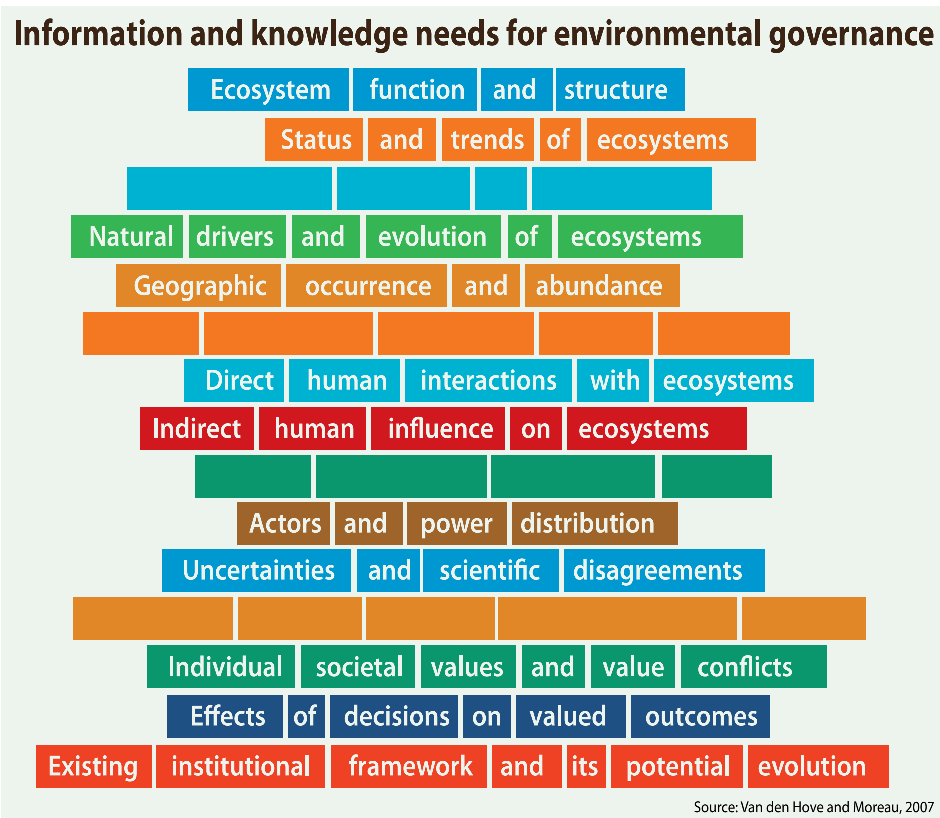

Figure 6.4 Information and knowledge needs for environmental governance.

The Papua New Guinea experience in deep sea mining

The first commercial deep seabed exploration and mining licences were granted by the government of Papua New Guinea in 1997 and 2010 respectively. These actions drew expressions of concern from international and local communities about the unknown risks associated with deep sea mineral exploration and mining and the potential threat to marine resources and ecosystems.

Papua New Guinea state agencies also expressed concerns, such as:

- the impact of deep sea mining on fish stocks (National Fisheries Authority);
- duplication of regulation mandates (National Maritime Safety Authority, Chief Inspector of Mines, Department of Labour and Industrial Relations);
- the availability of manpower for required functions (Department of Environment and Conservation; Department of Provincial Affairs and Local Level Government); and
- landowner identification in an offshore context (Department of Lands and Physical Planning).

The overriding concern was the absence of an offshore mining policy and legislative framework. Pre-existing mineral laws (designed for terrestrial mining projects) were used to issue the licences. In the 1990s, the Papua New Guinea government embarked on an initiative involving various leading authorities and experts on maritime matters, which led to the 1999 *Madang Guidelines: Principles for the Development of National Offshore Mineral Policies* (SOPAC 1999).

Papua New Guinea has identified that, while its existing legislation provides a sound framework for regulating offshore mining, the terrestrially focused mining regime does not address UNCLOS, the *Convention for the Protection of Natural Resources and Environment of the South Pacific Region* (the Noumea Convention), and other international maritime conventions. Policy and legislative reforms are therefore required. The Papua New Guinea government commenced work on a draft Policy on Offshore Mining and associated recommendations for legislative reforms. This policy imposes an obligation on all relevant government agencies to regulate offshore mining in accordance with the provisions of their respective Acts and Regulations.

A number of reforms and amendments to Papua New Guinea's Mining Act 1992, the Mining (Safety) Act 1997, and the Environment Act 2000 have also been proposed to cater to the specific circumstances of offshore and deep sea mining and ensure consistency with international obligations. They include:

- undertaking a strategic environmental assessment of the entire Papua New Guinea continental shelf to map the distribution of all seabed and sub-seabed resources, including minerals, oil and gas, fisheries, and biodiversity resources, and developing a marine spatial plan for the continental shelf to separate conflicting resource uses;
- based on the assessment, identifying high-priority deep sea biodiversity resources and protecting at least 20 per cent of the continental shelf as seabed protection areas over biodiversity hotspots, where seabed mining is prohibited;
- amending the Mining (Safety) Act to ensure that the mining equipment and operations on any mining ship are subject to that Act and the maritime safety regime, and that the overall design and the maritime (navigational) operations of any mining ship and any support vessels are also subject to the maritime safety regime; and
- developing an Environment Policy on Offshore Mining (as a regulatory tool under the Environment Act), so as to tailor the provisions of the Environment Act to the specific requirements of regulating offshore mining and for other purposes, such as implementing relevant elements of the International Marine Minerals Society Code of Environmental Practice for Marine Mining and other relevant international standards, in Papua New Guinea.

The development of Papua New Guinea's draft policy is guided by the Madang Guidelines, but reflects the country's circumstances and remains within its existing legal and policy framework. It is anticipated that the Papua New Guinea government will endorse the draft policy by 2013-2014.

The government also acknowledges the urgent need to submit Papua New Guinea's Archipelagic Baseline claim to the United Nations and to pass the relevant national legislation – the Maritime Zones Bill – to lay claim to over 2.5 million square kilometres of ocean area. In collaboration with neighbouring countries, Papua New Guinea has already submitted the claim to extend its continental shelf on three fronts under Part VI of UNCLOS to the Commission on the Limits of the Continental Shelf.

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7.0 The Sustainable Management of Deep Sea Mineral Wealth

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Deep sea mining has the potential to generate significant benefits for Pacific Island states. To secure these benefits it will be critical for Pacific Island states to establish a proper regulatory framework. The focus of this chapter is the collection and management of revenues from deep sea mining.

Many Pacific Island states have no experience with the extraction of natural resources and, therefore, do not have fiscal and revenue management regimes for mining. It will be important for these countries to develop and implement proper fiscal and revenue management regimes to ensure that the government receives an adequate share of the wealth created by deep sea mining and manages these revenues in a responsible manner. These regimes will be important protection against the potentially adverse economic impacts of deep sea mining, such as macroeconomic destabilization, particularly when there is limited economic activity beyond the extractive sector. Moreover, as a national economy becomes more dependent on deep sea mining, it will experience associated inflationary pressures and exchange rate overvaluation. Local populations will then face an increased cost of living. Even developed economies, such as Canada and Norway, have suffered from these negative impacts, often referred to as the Dutch disease. Smaller, less developed countries are particularly vulnerable, especially if they do not have adequate fiscal and revenue management mechanisms.

7.1 The framework-institution-governance paradigm

While interest in deep sea minerals began in mid-1960s, it is only recently that high commodity prices and technological developments have made mining them economically viable (Rosenbaum 2011:6). Pacific Island states wanting to develop their newly-discovered deep sea minerals will face a number of challenges. The biggest challenge for any government will be balancing the expectation that all will share in the country's resource wealth against ensuring a favourable climate for investors. Exploring for mineral resources is an expensive and high-risk activity, and there is the very real possibility that investors will incur significant sunk costs if a commercial discovery is not made. Given the long life of mining projects, investors will make investment decisions based on the expected returns over the life of the project. Having committed to the high risks of exploration and having made a commercial discovery, investors will be looking for fiscal stability over the life of the project.

Investors' demand for fiscal stability can make it difficult for governments to change the fiscal regime mid-project. The challenge is to design a fiscal regime that encourages prospecting activity (without the expectation of significant state income during these phases) but ensures that the government obtains an adequate share of the profits arising from any successful mining projects. If an effective fiscal regime is not in place at the commencement of the investment, then balancing the demands of investors against the expectations of the population to share in resource wealth, particularly in times of high commodity prices, can be very difficult.

Another challenge concerns the management of resource revenues. This has two aspects. First, it is important that mechanisms are in place to ensure transparency in the management of revenues and to prevent rent-seeking and corrupt practices. Second, the non-renewable nature of deep sea minerals means that governments must ensure inter-generational equity in the sharing of resource wealth. This involves future generations being able to benefit from the resource wealth, even after the resources have been fully extracted. A government must therefore determine the best mechanisms for achieving this - such as establishing a savings fund - and find a way to balance saving requirements with the need for infrastructure development.

An important challenge for governments is managing the macro-economic environment to avoid or limit the possibility of suffering from the Dutch disease and other adverse economic impacts (Figure 7.1). Experience has shown that countries that have successfully developed their extractive industries, whether petroleum or mining, have in common:

- well-enforced legislative and regulatory frameworks;
- strong institutions with adequate capacity; and
- good governance according to widely-shared principles.

7.1.1 The necessity of adequate frameworks

A regional or national minerals policy will benefit from a foundation of good governance and management principles (Figure 6.3; UNEP 2007).

Adequate frameworks refer to the legal and regulatory arrangements that are required in order to provide the laws and rules under which deep sea mining activity occurs. They might include sectoral laws, fiscal regimes, joint-mining agreements, environmental laws, revenue management laws, licensing, and any other secondary legislation and regulations (Figure 7.2).

In devising legal and contractual frameworks, it is important to entrench internationally accepted standards and practices concerning natural resource sector administration and management in a manner that is tailored to the circumstances of the country concerned. Legislation should reflect best international practices for transparency in decision making, include measures designed to uphold accepted standards of corporate responsibility, and en-

The Dutch Disease

The Dutch disease is a reference to the experience of the Netherlands in the 1960s when natural gas was discovered in the North Sea. The export of extracted resources results in an appreciation of a country's exchange rate, making exports of other commodities (such as agricultural products) more expensive in international markets and making local products less competitive with imports in local markets. Further, labour and materials are diverted to the extractive industries sector, which results in an increase in their price for other sectors of the economy, thereby increasing costs in those other sectors (Humphreys *et al* 2007).

Figure 7.1 Inter-linked components for successful oversight of the extractive sector.

hance the developmental benefits for the country when extraction occurs. There are several reasons why comprehensive legislative and regulatory frameworks are essential to the governance of deep sea mining. As a first step, foreign investors require a basic framework of rules to minimize the risks associated with their investment. In particular, foreign investors are looking for:

- macro-economic and socio-political stability; and
- legal, regulatory, and fiscal frameworks that are clear, transparent, predictable, and efficient.

The fiscal arrangements must balance international competitiveness (in order to attract and sustain foreign investment in the deep sea mining sector) with fiscal benefits for the host country. This is not an easy balance to strike. At least one important feature of an adequate fiscal regime is its progressivity. A progressive regime ensures that the government will be in a position to capture a higher share of fiscal benefits as a project's profitability increases. There is a specific discussion on the issue of fiscal regimes in Section 7.2.

Decision-makers in the deep sea mining sector should apply internationally accepted best practice in environmental management, material stewardship, and social responsibility. This includes legal and policy measures that underpin environmental and social safeguards, such as requiring environmental and social impact assessments prior to granting rights to companies to engage in mineral exploration and development, as well as measures to support effective environmental monitoring and the mitigation of environmental damage.

In many countries, these frameworks have been developed and reviewed with the assistance of international organizations such as the World Bank, International Monetary Fund, UN agencies, and the Commonwealth Secretariat. These frameworks reflect international best practice and include provisions covering the whole spectrum of issues arising from deep sea mining activity.

7.1.2 The importance of proper institutions

In many countries where adequate legislative and regulatory frameworks exist, implementation has been a challenge due to a lack of institutional capacity, human resources constraints, and insufficient funding to develop this capacity. Strong and effective institutions are particularly important to the oversight of deep sea mining, and they need to cover the same broad categories as the frameworks: legal and contractual, fiscal, and environmental. For example, the first set of institutions would include a mining department that handles the activities of the sector, including implementation and monitoring of contractual agreements and management of licensing and mineral rights. This could be complemented by an independent mining board that would ensure additional oversight of the sector. The second category of institutions relates to revenue collection and finance, with the core institutions including the tax and customs authorities. The third category relates to institutions responsible for managing environmental and other issues, such as health and safety, waste disposal, and site rehabilitation.

To ensure better linkages between the mining sector and other sectors of the economy, holistic and multisectoral approaches to mineral development policy are needed. This necessitates coupling mineral sectoral policy with industrial policy and investment, trade, and market access agendas, as well as establishing new institutional arrangements that combine traditional mining institutions with those responsible for industry, trade, education, and science and technology innovation.

Unfortunately, institutions are often the weak link in the concept of framework-institution-governance. Institutions often lack the moral or practical authority to monitor compliance and enforce the frameworks. Silo mentality and interdepartmental rivalry are common. They may also have insufficient resources to ensure that the frameworks are implemented. For instance, tax authorities often have limited ability to determine tax liability, audit companies' tax filings, and adequately challenge these filings, if necessary, in order to ensure full tax collection.

7.1.3 Good governance principles

Good governance principles are also essential for the successful harnessing of mineral resources. The concept of governance is complex, but it can be defined broadly for the purposes of this chapter as the authority and capability of institutions to perform a clearly-defined role, with the support of the political class but without being subject to political interference.

In fact, one of the main governance issues occurs when institutions are bypassed by the political elite. As a result, the frameworks are often not properly and fairly administered. It is important to create credible platforms for public participation in order to facilitate proper oversight and to ensure the options for mineral development take into consideration the interests and expectations of all stakeholders. This requires providing adequate capacity to all state and non-state actors, including parliaments, civil society, and community-based organizations.

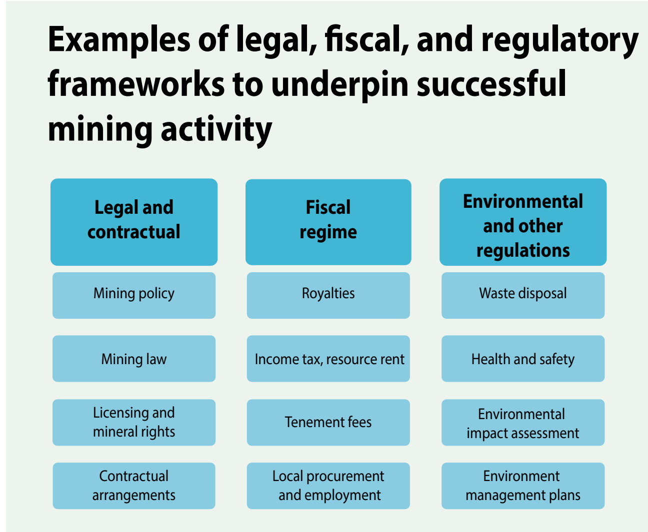

Figure 7.2 Examples of legal, fiscal, and regulatory frameworks to underpin successful mining.

7.2 The fiscal regime for deep sea mining

The fiscal regime for deep sea mining for a Pacific Island state must balance the need to attract foreign investment to develop the state's deep sea minerals with the needs of the people. The non-renewable nature of deep sea minerals means that the country must make sure it raises an appropriate level of revenues from its deep sea mineral fiscal regime at the outset (and continues to do so from prudent investment).

This implies that the fiscal regime must include a mix of instruments:

- pay-as-you-produce instruments that allow the government to obtain revenue as soon as commercial production starts; and
- profit-based instruments to ensure that the government captures a greater share of the deep sea mineral wealth as a project becomes more profitable.

Profit-based instruments are particularly important because deep sea mining, like other extractive industries, can give rise to economic rent. The discussion below considers the nature of economic rent, the broad principles that should govern the design of the fiscal regime, and the mix of fiscal instruments that could be used.

7.2.1 The rationale for special fiscal arrangements for mining

Deep sea mining, like any other extractive industry, has certain characteristics that distinguish it from other industrial undertakings. These characteristics – some of which are outlined briefly below – have implications for what might be an appropriate structure for the tax regime.

Deep sea minerals are a non-renewable resource that can be exploited once only, so the government has one chance to obtain a return from the nation's resources.

In natural resources, unlike other economic activities – where investors procure labour, various good and services, and, in particular, the raw materials necessary for the production of finished goods – the government is the owner of the resource. The government relies on investors to extract the deep sea minerals and is entitled to remuneration for the extracted minerals, just like any other supplier of goods or services.

Because of price fluctuations on world markets, there are risks associated with a deep sea mining project, related to the quality and size of the mineral deposit and the revenues to be received.

A deep sea mining project is likely to involve three broad phases of activity: exploration, mining, and decommissioning. These activities carry substantial costs, often incurred over long periods (20 to 50 years). High capital costs are typically incurred in the exploration phase and the decommissioning phase of a project, when there is little or no revenue. Further, exploration costs are an example of sunk costs, or costs that are incurred but cannot be recovered if exploration fails to result in a commercial discovery. This means that exploration is tax-sensitive. Once exploration expenditure is incurred, there is a lock-in effect. Provided there is a commercial discovery, an investor is likely to proceed to development (Boadway and Keen 2010:15). The speed with which investment can be recovered under tax rules, once revenue is generated, will be an important factor in deciding whether to proceed to development.

Deep sea mining is capable of generating economic rent. Economic rent can be taxed through appropriately designed fiscal mechanisms, without necessarily affecting investment decisions.

The costs and risks involved in natural resource extraction are not necessarily the same for all natural resources, so the level of economic rent will not be uniform. Even within the same resource, reserves and ore bodies may require different levels of effort, resulting in different rents. The less effort involved, the greater the potential rent (Kompo-Harms and Sanyal 2011:3). The total amount of economic rent that can be generated by a mine development is difficult to predict, especially in the case of deep sea mining where wide-scale commercial operation is untested and the technology uncertain. Thus, the methods used to capture any rent for the government must be flexible enough to respond to changes in actual profitability, instead of relying on predictions.

The exploration and extraction of deep sea minerals in Pacific Island states will be undertaken largely by foreign companies, either alone or jointly with a local company (for terrestrial projects this is often the state-owned mining company). There is also taxation in the investor's residence country, so the host country is not the only country taxing the revenue from a mining project. This is an important consideration in designing the fiscal regime in the host country (Boadway and Keen 2010:22-23). In particular, if the host country chooses to under-tax revenues so as to encourage investment, the tax revenue forgone by the host country may simply be collected by the residence country. Whether this happens depends on the method of relief from international double tax in the residence country. Further, the involvement of foreign companies opens the door to international tax planning opportunities – transfer pricing, thin capitalization, and management fees – designed to reduce taxable income under income tax and rent under a resource rent tax.

These special features of mine development and investment have been recognized by many governments around the world and explain why those governments have established tax arrangements for the mining sector that take these factors into account.

7.2.2 Government take

The principles identified above can govern the selection of fiscal instruments. However, the ability of a fiscal regime to succeed in attracting and retaining investments in the deep sea mining sector will depend on the overall fiscal burden it imposes. This fiscal burden is often called the government take or global take, and it serves as a useful benchmark for governments and mining companies alike when evaluating the fiscal burden of a regime and comparing it with others internationally.

Resource rent

The extraction of natural resources is a special form of economic activity because of the possibility that it will generate economic rent for the investor. In broad terms, economic rent is created when a project generates an excess of revenues over and above the costs uplifted by the rate of return, considering the risk of the project (Garnaut and Ross 1975:273; Baunsgaard 2001:5). In other words, if an investor earns a return significantly above what is normally expected from a specific economic activity, there may be existence of a rent. This may arise, for example, where the market values of the target metals significantly increase during a mining project.

Under normal market conditions, the possibility of economic rent exists only temporarily because the opportunity to earn economic rent will encourage both new entrants into the market and existing participants in the market to expand their productive capacity (Henry *et al* 2009). The increase in supply will have the effect of reducing prices and the increase in demand for productive assets will have the effect of increasing costs, returning market participants to the position of obtaining only a normal return on their investment. However, the extraction of natural resources often results in long-term economic rent because of the existence of barriers to entry for the new participants.

Provided an investor obtains a normal return for their investment, it is generally assumed that the investor will remain in that activity. Thus, in theory, a government could tax the entire economic rent arising from the extraction of natural resources, leaving an investor to make a normal return and not distorting investment decisions.

However, a government faces information problems in taxing economic rent. First, it is difficult for a government to know what the investor's rate of return is for a given project. Secondly, economic rent is determined over the life of a project, and therefore, the full level of economic rent will not be known until the end of the project. There will be uncertainty as to revenues and costs over the life of a project due to geological uncertainty (i.e., uncertainty about the quality of the resource) and because of market price fluctuations. It is possible that geological uncertainty can be managed through a portfolio of projects, which means that an investor can cope with some exploration failures. However, market price fluctuations can have a serious impact on the level of economic rent earned by a project.

A government will not usually seek to tax away the entire economic rent from a natural resource project because of the information problems relating to the investor's rate of return. The investor will obtain some of the rent as compensation for risks associated with the project. The key issue will be the allocation of the economic rent between the investor and the government. This is discussed further below.

In broad terms, the government take is the percentage of the overall share of the net cash flow generated over the life cycle of a project that will be taken by the government through the mix of fiscal instruments.

7.2.3 Principles of modern mining taxation

Given the special nature of deep sea mining, and recognizing the very small administrations of most Pacific Island states, the following principles are crucial to designing a modern and efficient fiscal regime that is capable of balancing the legitimate objectives of host governments and reasonable requirements of mining companies.

Simplicity

The fiscal regime should be as simple and straightforward as possible. That will make it easier for investors to understand and for government officials to explain, administer, and – where it contains any negotiable item – to negotiate. Tax measures designed on this basis are less likely to present loopholes for international mining companies to exploit and will reduce the incidence of lengthy and costly tax disputes.

Built-in flexibility

The fiscal regime should be flexible, so that the fiscal burden automatically adjusts to accommodate the profitability level of a mining project. The need for such fiscal flexibility, which is characteristic of a progressive tax regime, arises for the following reasons:

- The underlying economic potential of different mining projects varies significantly. The profitability distribution of mining projects is very wide, and the factors affecting profitability are numerous. In the case of deep sea mining, type of minerals, grade, density (in the case of nodules), depth, and technology all have an impact.
- Mineral commodity markets and prices are volatile and often fluctuate widely during the project life cycle.

Fiscal flexibility is therefore desirable for mining. First, it imposes a relatively lighter fiscal burden upon mining projects of marginal profit potential, thereby increasing the likelihood of such investments being made in the first place. Secondly, a progressive tax regime enables the government to capture automatically some of the surplus or economic rent associated with the development of mineral deposits of exceptional quality and/or that can be mined at unusually low costs, as well as any windfall profits from especially favourable market conditions. Thirdly, because the fiscal burden adjusts automatically to reflect actual profitability, it removes incentives for either party to seek a re-negotiation of terms. Thus, fiscal flexibility can contribute stability to the government-investor relationship.

The design of a progressive fiscal regime requires that one or more of its elements be profit-related (Figure 7.3). The most common approach is to establish taxes whose rates rise progressively as the mining company exceeds pre-agreed profitability thresholds. Indonesia, for example, employs progressive royalty rates, whereas in Australia, the United States, and Canada, royalty and profits tax may be combined to achieve this effect. Increasingly common among countries are variable-rate income tax (South Africa, Botswana, Namibia, Uganda, and Zambia) and resource rent taxes.

Stability

In order to create a positive climate for mineral investment, it is necessary that fiscal arrangements for mining are perceived by investors as having long-term stability. Uncertainty about future tax obligations adds to the inherent risks of the mining industry and is likely to increase the risk premium required by potential investors. The result may be that a government will either have to pay a higher price (in terms of lower tax revenue) in order to attract investment or lose investment in the mining sector altogether, leaving some potentially viable deposits undeveloped.

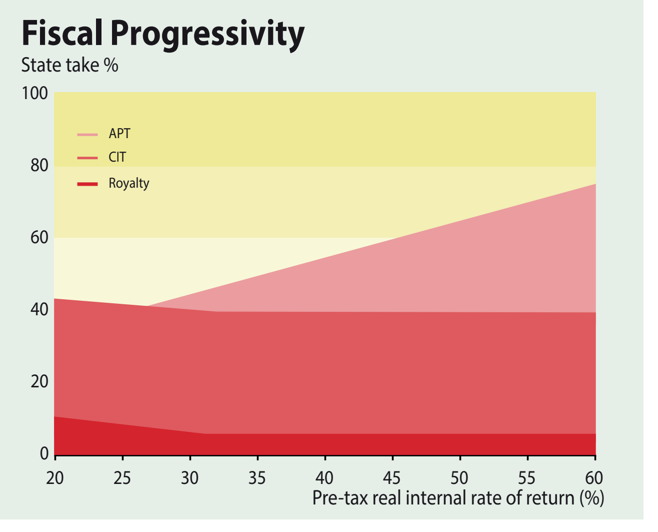

Figure 7.3 Illustration of fiscal progressivity. *This figure shows the contribution of three different fiscal elements to the fiscal burden on a mining project: corporate income tax, additional profits tax, and royalty. The burden is measured in terms of state take (y-axis) at progressively higher levels of project profitability on a pre-tax basis (x-axis). Whereas the combination of royalty (at 5 per cent) and income tax (at 35 per cent) results in a state take of close to 40 per cent, the additional profits tax is triggered in stages to achieve a higher level of state take as project profitability increases. (APT – additional profits tax; CIT - corporate income tax; IRR – internal rate of return).*

One way in which to lend stability to the fiscal regime is to ensure that it has the kind of built-in flexibility discussed above.

Low front-end loading

Given the high risks associated with mining, and the high capital costs and special financing needs of many medium/large-scale mining projects, the fiscal package should be structured so that the fiscal burden is low in the early period of mining operations, when investors are still recovering initial capital outlays and servicing project loans. This calls for reasonable rates of royalty, special arrangements with respect to capital allowances for income tax purposes – which permit rapid recovery of initial capital expenditures – and, sometimes, concessions on input taxes, such as import duty.

Minimum government receipts

The government should, in all cases, be assured of receiving some tax revenue from a deep sea mining project whenever deep sea minerals are extracted and whatever the economic circumstances of the project. It is a widely-held principle that the owner of non-renewable resources is entitled to payment for the right to deplete such resources. The opposite would mean giving away a country's assets at a selling price of zero. If a mining project is not profitable enough to pay for the depletion of the resource, a government would be better off leaving the resource unexploited until market conditions are good enough to assure proper compensation for its extraction.

Including a royalty in the fiscal package assures the government of a minimum revenue stream whenever mineral production occurs. The royalty calculation and payment is normally based on the value of the minerals produced, also called ad valorem. The royalty rate should be fixed at a relatively modest level (between 3 per cent and 7 per cent). Although ad valorem royalties have been a feature of the vast majority of mining fiscal regimes around the world, the economic effect is regressive because it is based on revenues rather than profits. There is now a trend to move toward profit-based royalties or hybrid royalties in order to improve progressivity while ensuring minimum tax revenue (Otto *et al* 2006). However, these types of royalties are more complex to administer, and companies can often display little or no profit, especially in the early years, defeating the initial purpose of ensuring minimum revenues for the government.

Avoidance of tax leakage

One of the main challenges for Pacific Island states will be avoiding tax leakage. Tax leakage occurs when tax revenues are lost despite, or because of, tax provisions. It can be the result of a mixture of non-compliance and/or non-enforcement, transfer pricing, illegal mining activity, or deliberate tax concessions. Tax leakage tends to flourish when government capacity to administer the sector is weak and there are complex tax rules, that create opportunities for avoidance, particularly in the absence of proper monitoring of companies. A simpler tax system with fewer reliefs, exemptions, and loopholes tends to reduce tax avoidance in the long term. The international trend has been to broaden the tax base by reducing or eliminating discretionary incentives and exemptions.

Where mining involves foreign companies, tax leakage can also occur as a result of tax concessions that give the companies lower tax liabilities in the host country and allow them to transfer abroad profits that are then liable for taxation in home jurisdictions

Tax neutrality

The mining fiscal regime should, as far as possible, not distort investment decisions by providing incentives for actions that would not otherwise have been taken. Such incentives can take a number of forms. Tax allowances and deductions in excess of 100 per cent of expenditures will tend to encourage expenditures that are not operationally justified.

7.2.4 Determining an appropriate level of government take

In establishing an appropriate target for the government take from deep sea mining, a government may consider several factors, including:

- the geological prospectivity of the country and its infrastructure and general business climate;
- the absence of any existing commercial deep sea mining operations and the uncertainties concerning the technology and, therefore, the level of economic rent that can be expected from the industry;
- the success that the country has had in attracting other mining investment;
- the level of taxation of domestic businesses; and
- the fiscal conditions of other countries presenting similar investment opportunities.

If it is government strategy to encourage new mining investment, it will have to consider whether the level of government take is sufficiently competitive to attract such investment. In today's environment, where access to resources is becoming increasingly difficult and expensive, governments can aspire to attract new investment without having to lower their requirements in terms of government take.

Government fiscal policy must be framed, therefore, in terms of its objectives for mining sector development, the country's mining development stage, the country's unique set of circumstances, and changing competitive conditions in the international mining industry. There is no single level of government take that would be universally appropriate or acceptable to all governments or to all types of extraction. Given the uncertainties involved with deep sea mining, a government might seek a global take in the order of 40 to 55 per cent.

7.2.5 Mix of tax instruments

The special nature of deep sea mining and the desire to achieve a specified level of government take necessitates a mix of fiscal instruments to ensure both that some revenue is paid to the government from the start of commercial production and that the overall level of revenue collected by the government adjusts, to some extent, with profitability. If the only revenue instrument is income tax, there would be a significant delay in the government's revenue from the extraction of deep sea minerals. This is because the deduction for exploration and early development expenditures creates large carry-forward losses. Therefore, it could take many years for an investor to have a taxable income from a project. Indeed, if the deposit is not as extensive or valuable as originally thought, the government may receive no revenue at all from its depleted resources under profit-based instruments.

For deep sea mining, three fiscal instruments could be considered: royalties, corporate income tax, and a resource rent tax.

Royalties

Royalties, although regressive, provide a guarantee of minimum revenue for the government. Generally, royalties are simple and can be estimated and collected easily. A royalty may be specific or ad valorem. A specific royalty is based on production volume, while an ad valorem royalty is based on production value. A specific royalty is simpler to administer and harder to avoid, provided production levels can be monitored, but is not responsive to price changes. It lacks progressivity and favours the capture of the resource rent by the investors. Its use is therefore often limited to industrial minerals.

An ad valorem royalty is more progressive since it increases as mineral prices increase. It is considered a fairer approach, since it rewards the country with a higher compensation as the value of their depleted minerals increases. It is, however, more complex, as the value of the resource should not include the value added by downstream processing. This will be a particular issue for deep sea mining in Pacific Island states, since processing is likely to occur after the minerals have left the country's tax jurisdiction.

The difficulty is that there may not be an arm's-length price at the point of extraction, which could be used to determine the amount of the royalty. This means that the value of the resource is often based on an observable downstream value netted back to the point of extraction, adjusting for transportation and other downstream costs. The downstream value is usually based on the first sale or the fob value for export, whichever occurs earlier. Fob means free on board. The seller pays transportation and insurance costs to the port of shipment, and the buyer pays for freight, related costs, and insurance costs thereafter. In the context of deep sea mining, fob is essentially the export value of the extracted material. A particular difficulty in imposing royalties in relation to minerals extracted from the seabed is that the mineral content of the ore may not be known until it is processed. Since the processing is likely to be in a different country, it is difficult to apply different royalty regimes for different types of minerals. The fob value may need to be based on assumptions as to the likely mineral content. Further, while an ad valorem royalty is responsive to price changes (but not changes in cost structures), it is open to avoidance by undervaluing the extracted resource through related party transactions.

Corporate income tax

Normally, a country's corporate income tax represents the core of taxation revenues for any economic activity in a country. As the corporate income tax applies to all forms of economic activity, the rate of tax is set on the assumption that taxpayers earn a normal rate of return. Nevertheless, if a country's general corporate income tax is high enough to reach the targeted level of government take, few changes need to be made to the country's income tax legislation. If the general corporate income tax rate is too low to achieve a targeted government take, a special rate should apply for deep sea mining. Alternatively, a resource-rent taxing instrument (see below) could be used.

Because it allows depreciation of capital investment expenditure and deductibility of most expenses, corporate income tax captures the specificities of each mining project and should link the tax burden with the project's level of profitability. However, mining companies have historically been successful in minimizing their tax liabilities from a worldwide perspective. Countries new to mining need to ensure that the corporate income tax has protections in place to deal with tax minimization practices, such as transfer pricing, thin capitalization, management fees, finance leases, and tax treaty shopping.

In some cases, it has proved very difficult for countries to assess the proper level of taxable income and determine the level of tax liabilities. Because of that, even though it is based on profits, corporate income tax has often not been the progressive tax instrument it should have been. This is why countries have been looking at other options such as resource rent tax.

Resource rent tax

Resource rent tax is also known as additional profits tax. Due to the yet-unknown profitability of deep sea mining, and to enable capturing any potential economic rent, a resource rent tax is strongly recommended as part of any deep sea mining fiscal regime.

There are numerous variations of resource rent tax, but they can be grouped in two main systems:

- R-factor systems, which are linked to payback of the investment; and
- rate of return systems, which are linked to the rate of return of a project, normally on a cumulative cash-flow basis (Garnaut and Ross 1975, 1979; Garnaut and Clunies-Ross 2012).

A resource rent tax is potentially very complex. However, Pacific Island states are likely to employ a simplified version of the rate of return approach, using taxable income under the corporate income tax as the starting point and then making adjustments to convert taxable income into an annual cash-flow amount. Resource rent tax will be payable only when the investor has a positive cash flow after recovering capital costs uplifted by an amount to reflect the investor's rate of return.

In both cases, the result is that the additional tax is imposed only when the return from a project exceeds some threshold return, considered as a normal rate of return for a specific type of project. Marginal or average-profitability projects should not be subject to the resource rent tax, but once a project reaches a high profitability threshold, an additional share of the profits becomes due to the government. A resource rent tax, therefore, is a highly-progressive tax instrument that should not affect a company's investment decisions, while ensuring that the government take increases when mining companies benefit from supernormal profits.

7.2.6 Fixed or negotiable terms?

A further consideration in the design of the fiscal regime is whether elements of the regime should be left open to negotiation. There has been significant debate about whether terms should be fixed or negotiated on a project-by-project basis. Indeed, the previous practice of individually negotiated agreements is currently being revisited by many states, particularly in cases where the terms were negotiated in a non-transparent manner.

A regime that is composed entirely of fixed elements, leaving no margin for negotiation, has the merits of simplicity and ease of administration. Some argue, however, that it presents a potential investor with terms on a take-it-or-leave-it basis. In practice, large companies may have the upper hand in private negotiations because they can fund greater legal and financial resources than the government. Also some countries compete with each other by offering more favourable terms in order to attract foreign investment, to the detriment of the country's development.

Experience suggests that, in general, one-on-one negotiations between governments and companies have led to more favourable terms for the companies. This implies that governments would serve the interests of their countries more effectively by moving towards fixed terms for investors and conducting negotiations on a minimum of elements, always on an open and transparent basis.

7.2.5 Conclusion on fiscal regime and fiscal policy

A government's fiscal policy can have a significant influence on the pace, intensity, and efficiency of deep sea mining development. A mining fiscal regime must be designed in such a way as to be attractive enough to investors that mining investment occurs, while at the same time obtaining an appropriate and fair share of revenue from mining operations for the government.

The economic arguments presented in this chapter lead to the following conclusions:

- In devising a fiscal regime for mining, it is essential to recognize that mining investment capital is internationally mobile and ensure that the investment terms offered remain attractive to investors.
- A government that carefully structures its tax system to reduce the risks faced by investors can, in the long run, secure more investment and higher tax revenue over the life of a deep sea mining project.
- Mining tax policy is concerned not only with the sharing of revenue between the government and investors, but also with creating an environment conducive to investment, which influences the magnitude of economic rent generated in the long term.

An efficient and well-designed package of tax measures, therefore, will not only generate an appropriate level of tax revenues from existing mining operations, but will also attract new exploration and mining investment, thereby sustaining or even widening the tax base in the future.

7.3 State participation

State participation – the assumption of an equity interest in a mining project – is an arrangement adopted by some governments as a matter of policy choice. Although quite common in petroleum projects, state participation is much less common in mining projects. The main cases where it has occurred are related to precious minerals and stones, such as diamonds. Accomplished through joint ventures, these participations have been justified for a variety of reasons, among them:

- the need to capture a higher share of the economic rent generated by the mining sector;
- the need to assure the transfer of technology, management experience, and operational skills to nationals;
- the need to monitor and direct mining operations;
- the need to maximize local development benefits from mining; and
- the need to assert influence in international mineral trade and markets through control of supplies.

A policy that is based on state participation has important fiscal repercussions. By participating in mining ventures, a government is at risk of conflict of interest arising from its dual role in relation to the project, as both joint venturer with a private investor and regulator and agent of the government. Indeed, investors may prefer some level of state participation because the conflict can work in their favour.

Further, the government assumes a portion of the risk associated with mineral exploration and development and must meet its share of costs and financial losses. For instance, in difficult times, shareholders may be called upon to provide a cash injection into the enterprise or guarantee new loans. Even when a joint venture enterprise is highly profitable, dividend payments to the government may be modest if funds are needed for capital expenditures, debt repayments, or increases in working capital.

Moreover, state participation in mining projects is not as effective a mechanism for a government to capture economic rent as other fiscal mechanisms that are geared to the profitability of mining projects. All but the last of the above-listed objectives of state participation can be achieved through appropriate administrative and regulatory mechanisms, without the need for government to take a financial stake in mining enterprises.

7.4 Managing deep sea mining revenues

A deep sea mining project has a limited time frame. Since mineral resources are limited, the mineral wealth derived from them will ultimately be gone. This raises the issue of intergenerational equity – ensuring that future generations benefit from deep sea mining wealth once the minerals are depleted. In developing countries, managing resource wealth involves balancing the need for current expenditure to achieve economic growth and poverty reduction against the entitlement of future generations to share in the national wealth.

Inter-generational equity is achieved by converting the country's deep sea mineral stock into capital assets. This can be achieved through either or both of the following:

- the investment of natural resource revenues in financial assets through the use of a sovereign fund; and/or
- the investment of the revenues in developing skilled human resources and infrastructure assets, such as roads, ports, schools, and hospitals.

The discussion below focuses on the use of a sovereign fund to ensure that future generations share in a country's deep sea mineral wealth.

7.4.1 Permanent-income hypothesis

One of the best ways to address the temporary nature of deep sea mineral wealth and to ensure that future generations will also be able to benefit from a country's endowment is by converting annual revenues into long-term payments that could benefit the population indefinitely. This can be achieved by saving some of the annual revenues according to an approach called permanent-income hypothesis. Under the permanent-income hypothesis, it is intuitively implied that optimal government use of natural resources revenues should be constant over time and equal to the annuity value of wealth. This would be represented by the green line, in Figure 7.4. Because of its simplicity and its powerful predictions for fiscal policy, the permanent-income hypothesis is a good tool to manage deep sea mining revenues.

Permanent-income hypothesis and its applications

The concept of permanent-income hypothesis (PIH) was initially developed by Nobel Prize recipient Milton Friedman of the University of Chicago. Friedman's idea was that consumption and savings decisions are more affected by changes in permanent income than by income changes that are perceived as temporary or transitory. Using this concept in the management of natural resources wealth allows a country to convert unequal and fluctuating yearly natural resources revenues (red line) into a level amount (green line).

The concept allows five things:

- Because it is based on the total natural resource wealth, both present and future revenues are taken into account, allowing withdrawal of a substantial proportion of the yearly revenues in the early years.
- As mining activity increases, a higher and higher proportion of this yearly revenue goes into (and remains in) a natural resources fund as savings for future generations.
- Since calculation parameters are reviewed every year, there is a continuous adjustment of that proportion. However, since these adjustments are based on long-term forecasts of objective economic parameters (including commodities prices), the process absorbs the cyclicality and prevents abrupt corrections on a year-to-year basis.
- Since the level of yearly disbursement and spending is entirely determined by a formula, rather than arbitrarily decided by policy makers, the annual withdrawal is depoliticized.
- Finally, if used properly, this approach allows the country to build a sufficient balance in the fund, which has always been a difficult objective to achieve.

Ultimately, as resources become depleted and mining activities cease (in 2040, in Figure 7.4), future generations will continue benefiting from a permanent annuity payment from the fund, bringing true inter-generational equity (Dumas 2010).

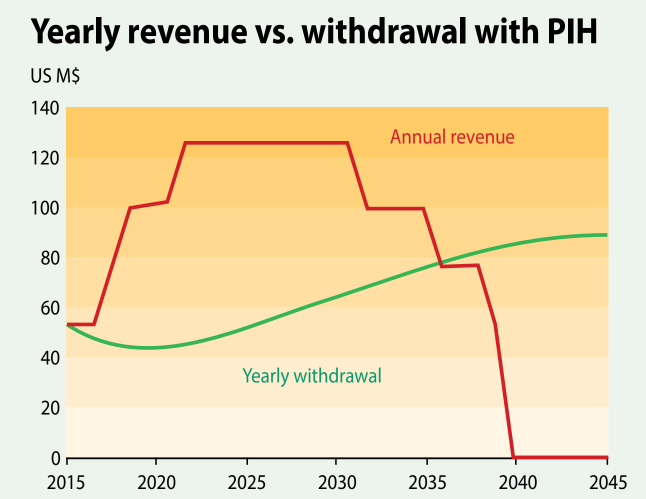

Figure 7.4 Yearly revenue vs. withdrawal with permanent-income hypothesis (PIH).

7.4.2 The issue with savings and spending

As noted above, a key success factor in managing deep sea mineral wealth is to separate the decision of how much to spend from the decision of how it should be spent. Some of the most successful funds have achieved this by transferring a single amount to the overall state budget. Budget allocations and spending decisions are then governed through the regular budgetary process. In fact, some argue that a fund with its own spending program would divert important spending decisions and priorities to non-elected officials. As the amounts involved could become significant, this would effectively create a state-within-a-state.

The remaining question, therefore, is how much to spend. The level of spending should be related to the strength of the country's governance and institutions. Possibilities range from leaving the amount spent yearly entirely to the discretion

Potential structure of a mineral fund

In order to be able to set aside deep sea mining revenues for future generations, it is strongly recommended that countries create a specific independent fund in order to isolate the savings from any other use. Although there are a multitude of variations in the design of such a fund, issues of transparency, governance, and accountability are essential. To avoid its capture by political elites and ensure better development outcomes, independent management and oversight of such funds is recommended. Figure 7.6 presents one example of a natural resources fund.

Revenues are paid directly into the fund and are invested in secure financial assets, mostly outside the country. Investment strategies are determined by an investment committee, and funds can be managed by the central bank. Each year, the ministry responsible for finance determines the amount that can be withdrawn and transferred to the government's consolidated account.

Governance is assured by an independent oversight committee, which reviews payments, calculation of the PIH-based withdrawal amount, and accurateness of information published. The independent oversight committee should also have the responsibility of auditing the fund's activities and transactions and should be accountable to the highest authority, such as the country's parliament.

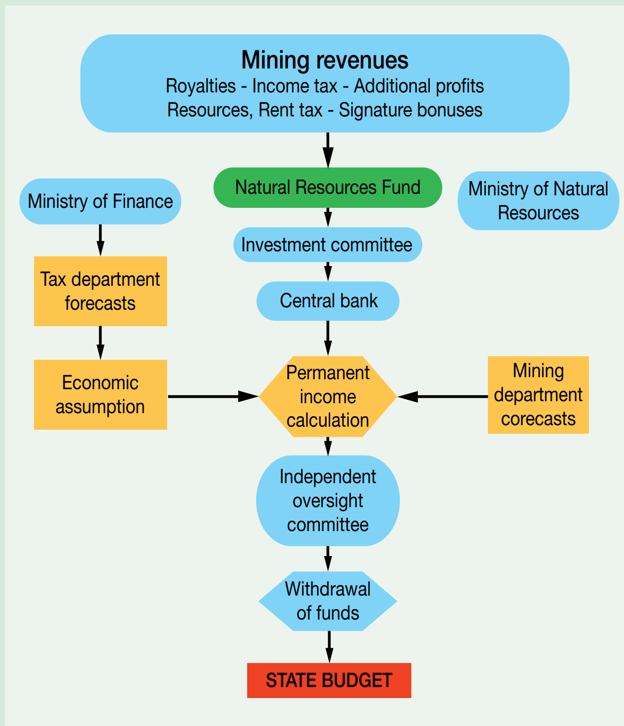

Figure 7.6 A simplified structure of a natural resources fund, its actors and functions.

of policy makers, current and future, as in Norway's case, or determining the level of spending by law, as in the recent cases of São-Tomé and Timor-Lesté (Figure 7.5).

7.4.3 The Five Ss of natural resource revenue management

Fulfilling the potential of natural resources wealth is neither assured nor automatic. With sudden inflows of natural resource revenues, governments face a number of challenges. Among them are the variability of fiscal revenue related to fluctuating commodity prices, the issue of the Dutch disease and domestic inflationary pressures, and how to save a portion of the revenues for future generations, while addressing immediate development needs in health, education, and infrastructure.

All too often, mining revenues have been used not for positive social transformation but for short-term or narrowly focused political agendas.

Sound revenue management will ensure that the correct balance is struck between saving revenue for future generations and spending current mining revenue on projects with long-term benefits.

Level of discretion

More discretion ↑ / Less discretion ↓	Inflows	Quantitative constraints	Qualitative constraints
Norway	All oil revenues enter the fund	Parliament is unconstrained, but politicians have committed not to spend more than 4 per cent of the balance of the fund per annum	Outflows cover balance of government budget decided by Parliament
East Timor	All oil revenues enter the fund	Parliament is unconstrained, but is supposed to stay within the highest amount that can be sustained in perpetuity (the permanent income from oil wealth). The formula is given by law. Special reporting and justification procedures must be followed if any amount exceeds the guideline	Outflows cover balance of government budget decided by Parliament
São Tomé et Príncipe	All oil revenues enter the fund	Outflows cannot legally exceed the highest amount that can be sustained in perpetuity (except in the transition period before regular oil production starts). The formula is specified in the law on oil revenue management.	Outflows enter the government budget directly, but must be used for development purposes
Alaska	A fixed proportion of oil revenues enters the fund	A formula governs the amount of money that can be paid out from the fund. The rules are enshrined in the State Constitution	Outflows can only go to citizens in the form of "permanent fund dividend" cheques. The rules are enshrined in the State Constitution

Figure 7.5 Level of discretion for natural resources revenue.

In order to guide governments about the most appropriate way to collect, manage, and disburse natural resources revenues, five issues are of particular importance and need to be taken into account to ensure sound revenue management. These issues are stabilization, sterilization, savings, socio-economic growth, and safeguarding revenue.

1. Stabilization: related to the need to protect against mineral resource price fluctuations. The idea of stabilization is particularly important in the case of mining since mineral prices, in the long run, tend to have a cyclical pattern. Stabilization would require that incremental revenues be set aside in a fund when commodity prices are high and taken out when prices drop, so that governments have a stable revenue stream.
2. Sterilization: involves keeping a large part of the revenue collected out of the local economy, so as to avoid excessive inflationary pressure. In other words, deep sea mining activity tends to create pressure on the domestic economy, by increasing demand for goods and services, and on the labour market, as well as creating inflationary pressures that can negatively impact industry and economic actors not involved in the extractive sector.
3. Saving for future generations: necessary to provide for future generations. Deep sea mineral resource reserves may be depleted within a period of decades, creating the prospect of great wealth followed by poverty for future generations – unless proper savings are made for the long term. Examples of countries with savings funds include Norway and, more recently, Timor-Lesté.
4. Safeguarding revenue: experience has shown that protecting the savings in the long run is not easy. It is necessary to have a separate funding vehicle for savings, governed by non-discretionary rules, so that governments are less tempted to spend these savings. One success factor is to have natural resources revenues paid directly into a separate fund. Withdrawals from these funds will follow a pre-determined formula based on the principle of the permanent-income theory, with as little discretion as possible.
5. Socio-economic development: although revenue should be set aside for future generations, long-term investments in human capital formation, infrastructure, and socio-economic projects should be made while mining is going on. Making good investments in health, education, roads, technology, and the like is also investing in future generations. The challenge is to invest in projects with long-lasting benefits. Also, as observed in some smaller countries, governments do not always possess the institutional capacity to deliver enhanced spending programs and to manage large projects.

The balance among these Five Ss will depend on a country's socio-economic context and specificities. However, this framework can be extremely useful as a natural resources management tool.

7.5 Conclusion

As discussed in this chapter, although deep sea mining can bring wealth to a country, fulfilling this potential is neither assured nor automatic. The extraction of non-renewable natural resources has often led to political instability, revenue management challenges, corruption, and increased social tension. It is therefore necessary for resource-rich countries to improve legislative and regulatory frameworks, build institutional capacity, and strengthen governance in order to ensure that the endowment of natural resources translates into a blessing and does not become a curse. In particular, a proper fiscal regime and long-term revenue management mechanisms are necessary to ensure inter-generational equity.

Vava'u Tonga. Photo courtesy of Robert and Elyse Brown.

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8.0 Deep Sea Minerals and the Green Economy

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This volume, together with volume 1 (SPC 2013) on deep sea minerals, provides an integrated examination for policy makers of the key aspects of mineral extraction, including the geological, biological, technical, social, economic, and fiscal components. These volumes have, for the first time, brought together international experts with a broad range of skills and backgrounds related to deep sea minerals. Consolidating this information to support decision making and the regional development of a legislative framework to underpin resource development, both within and beyond national jurisdictions, places the Pacific Island states at the forefront of responsible management of their non-renewable resources.

There are, sadly, many examples of terrestrial mining projects that have resulted in environmental damage, social dislocation, and low economic returns to communities. This history has increased the awareness of potential negative impacts within the communities assessing development projects, as well as in the general population. New industrial endeavours often face stiff opposition, and this is already the case with regard to proposed deep sea mining initiatives. The most advanced deep sea mining project, Nautilus's Solwara 1 in Papua New Guinea, has been the subject of sustained opposition from groups both within and outside the country. Evidence suggests that the developer, Nautilus Minerals, has worked to provide robust scientific information to assess the potential environmental impacts of mineral extraction. Nautilus has, for example, appointed highly qualified and respected academics and researchers and published results in peer-reviewed scientific journals. The company's message, however, does not necessarily reach or appease local people. Consequently, some communities remain unconvinced that the benefits of deep sea mineral extraction outweigh the risks.

People's response to scientific information about industrial risks is based upon their experience and how they view the credibility and trustworthiness of the institution providing the information (Wynne 1992). More is known about bad mining operations than good mining operations, due to the numerous well-publicized examples – including some projects in the Pacific. So, while international companies are trying to convince developing country stakeholders of their commitment to an era of new and greater corporate social responsibility, significant scepticism remains.

As an example, the Pacific Conference of Churches (the Pacific Island fellowship of churches representing more than three-quarters of the region's population) has called for a stop to any activities related to deep sea mining until more research has been undertaken on the potential impacts of both exploration and extraction on the environment. The Conference's General Secretary, Reverend François Pihaatae, urged governments to engage – not merely consult – with their people and ensure that proper studies are made before any work is done (Gibson 2013). Mining companies would argue that this is already happening – and indeed this is a requirement of international law to which Pacific Island states are legally bound to adhere.

8.1 Current prospects for deep sea mineral extraction

Mining companies are preparing to explore and extract minerals from the Pacific's seabed. The first commercial sea-floor massive sulphide mining venture looked on track to start in Papua New Guinea in 2014. However, a financial disagreement between the Papua New Guinea government and the mining company has halted the operation. The company had previously succeeded in obtaining a 20-year licence to mine in the Bismarck Sea, and recent statements by the company's chief executive suggest that they are still committed to the project (Island Business 2013). Other Pacific Island states are granting deep sea mineral exploration licences, and some are actively seeking foreign investment in this new industry. Fiji has issued two deep sea mining exploration licences – one to a South Korean company and another to a multinational company (Woodside 2012). Tonga, the Solomon Islands, and Vanuatu have also granted exploration licences. The Cook Islands has indicated its intention to open an international tender for exploration of parts of its manganese-rich seabed in 2014.

While commercial-scale deep sea mineral extraction within national jurisdictions might be considered to have stalled, progress towards mining within the international seabed area (the Area) is gaining momentum. The International Seabed Authority has, to date, issued 14 exploration contracts and another 5 are awaiting finalization (see http://www.isa.org.jm/). With the recent publication of a study providing a regulatory framework for the mining of manganese nodules within the Area (ISA 2013) the International Seabed Authority has suggested that companies could be in a position to apply for mining licences by 2016 (Shukman 2013).

Manganese nodules. Photo courtesy of IFREMER.

8.2 A framework for sound management

As interest in deep sea minerals has increased in the region and elsewhere, Pacific Island states have remained firm in their commitment to ensuring that this new industry will contribute to the long-term economic sustainability and social development of the host countries and, indeed, the region. As early as 1999, countries in the region convened a workshop in Papua New Guinea to highlight the new opportunities related to offshore minerals. They produced a set of guidelines, the Madang Guidelines (SOPAC 1999), to assist states in formulating effective policy and legislation for offshore mineral development. This early commitment to a regulatory approach to deep sea minerals (supported by the Pacific Islands Forum, the South Pacific Applied Geoscience and Technology Commission (SOPAC), and the Metal Mining Association of Japan) has since been expanded in the SPC-EU Deep Sea Minerals Project's Pacific Islands Regional Legislative and Regulatory Framework (SPC 2012) and is now being implemented through the development of world-leading national statutory regimes.

Pacific Island states recognize the importance of providing effective governance for deep sea mining, encompassing fiscal, social, and environmental regimes. Such governance is essential for ensuring that deep sea mining meets development objectives and provides a stable and transparent climate for investment. Experienced resource companies understand that irresponsible management of these issues reduces the prospect for long-term success and can lead to delays, shutdowns, and even closure of projects (Franks 2012: Table 2).

The SPC-EU Deep Sea Minerals Project, supporting Pacific Island states in developing effective policy and legislative frameworks to assess and manage deep sea mining developments, can also contribute to improving the functioning of regulatory bodies by building capacity across a range of issues. These include contract negotiation (addressed at a workshop in Tonga in 2013) public participation in decision making (addressed at a workshop in Vanuatu in 2013) and fiscal management of resource revenue.

Note that all workshop materials from the SPC-EU Deep Sea Minerals Project are available on the website at http://www.sopac.org/dsm.

Benefits for investors and developers	Benefits for regional, national, and community interests
Provides a healthy investment climate with greater certainty	Attracts good companies capable of compliance
Provides an agreed framework for negotiation	Provides an agreed framework for negotiation
Fosters long-term success by minimizing the potential for conflict-induced delays, shutdowns, or closure	Fosters long-term success by minimizing the potential for conflict-induced delays, shutdowns, or closure
Ensures more efficient and cost-effective project planning and implementation	Provides improved prediction of economic benefits – evolved tax regime, savings strategy, etc.
Increases access to a skilled and motivated work force	Enhances employment and training opportunities for local workers
Leaves a positive legacy beyond the life of the project	Sets high standards for other developments/businesses
Fosters development of best practice, supporting sustainability throughout the project life cycle	Increases environmental awareness, including economic valuation of ecosystems
Fosters development of new technologies and applications	Enhances access to new technology
Ensures compliance with international principles and standards	Ensures compliance with international principles and standards
Minimizes potential for supporting institutional corruption	Minimizes institutional corruption
Enhances overall project risk-reduction and realization of mutually beneficial outcomes	

Table 8.2 Benefits of an effective regional deep sea mining policy regime (adapted from Franks 2012).

Manganese nodules. Photo courtesy of IFREMER.

8.3 Deep sea mining for development

In addition to the need for a strong regulatory framework for deep sea mining, policy makers weighing the economic benefits and costs of deep sea resource development should consider the costs and benefits to society from any social and environmental impacts that result from mining, including damage to other components of natural capital. Otherwise, over the longer term, the development may constitute uneconomic growth, as opposed to true economic growth (UNEP *et al* 2012).

Determining the true value of deep sea minerals when additional factors, such as possible impacts on ecosystem services, are taken into account is challenging. The deep sea environment is one of the least understood regions of the planet. To avoid unintended consequences that might affect society through the loss of unaccounted-for (or unknown) ecosystem services, we need to rapidly increase our knowledge of these environments and to take management decisions that are informed by sound scientific information and guided by the precautionary approach. The value of non-renewable resources should not be measured simply in terms of their ability to generate monetary returns.

Hydrothermal vent fauna, Eastern Lau Basin. Photo courtesy of Chuck Fisher.

Mining is a finite economic activity, often with a short life span. Poorly governed deep sea mining, without consideration of environmental and social impacts, could leave a legacy of problems and lost opportunities long after the gains from development have been consumed. Past examples of resource extraction in the Pacific have damaged the natural capital inherited by today's generation. Natural resources underpin economic development, but in order to maintain natural capital for future generations, management needs to ensure that deep sea mining ends up improving a nation's combined economic, environmental, and social capital by generating net value. Marine mining has the potential to significantly degrade benthic ecosystems (UNEP *et al* 2012). The effective management of these ecosystems and the services they provide requires the application of best environmental practice, as well as spatial planning that includes the establishment of protected areas (Van Dover *et al* 2012).

When managing deep sea mining activities in the context of the sustainable use of the oceans, all stakeholders should be considered. These include those with non-commercial, subsistence, and traditional interests or concerns, other commercial interests (for example, oil and gas exploitation and fisheries), and, most importantly, future generations and their right to live in healthy and productive ecosystems. There is growing acknowledgment that human well-being is linked to environmental condition (Naeem *et al* 2009). Deep sea mining management practices should therefore be holistic, based on an integrated overview of all present and future human uses and ecosystem services. Essential questions that should be asked of any deep sea minerals development that is being considered by Pacific Island states include:

- Is the development going to provide significant economic benefit (including, but not limited to, revenues) when all costs, including environmental and social costs, are taken into consideration?
- Is the development going to contribute to local business expansion, enterprise development, employment, and overall strengthening and diversification of the local economy?

Transparency and accountability of mining revenue, as outlined in the Extractive Industries Transparency Initiative (discussed in Chapters 5 and 6), is essential for good governance. Ensuring that national authorities have the ability to regulate and tax non-renewable resources is of crucial importance to ensuring revenue contributes to sustainable economic growth and development for the society at large.

In addition to developments within the exclusive economic zones and continental shelf of Pacific Islands, states in the region have shown interest in sponsoring seabed mineral activities in areas beyond national jurisdiction. To date, three states – Kiribati, Nauru, and Tonga – have founded or partnered with companies in order to explore for manganese nodules in the Clarion-Clipperton Fracture Zone under contracts issued by the International Seabed Authority (see Text Box). The role of a sponsoring state is to have effective control of the company carrying out the exploration (or mining) work and to take ultimate responsibility for its actions and for any environmental damage that may occur. For this reason, states contemplating engagement in seabed mineral activities beyond national jurisdiction should:

- choose their partner company carefully;
- put in place robust laws and agreements with the company, designed to establish a relationship of effective control;
- implement those laws effectively; and
- ensure that the financial arrangements with the company provide sufficient benefit to the state to justify the costs and risks of sponsorship.

Pacific state mining agreements in the Area

There are two different agreement models:

1. Nauru and Tonga have provided sponsorship to companies that hold contracts with the International Seabed Authority and will perform the seabed mineral activities.
2. Kiribati holds the contract with the International Seabed Authority itself through a state-owned enterprise and will enter into sub-contracts with a company or companies for the performance of the seabed mineral activities.

Under model 1, the company is required to have a local office in the sponsoring state and is bound by the sponsoring state's legislation as well as any agreement made between the state and the company. Under model 2, unless the company is located in the state, the company will not be bound by the state's legislation. The legal relationship will be governed only by an agreement between the state and the company (which should reflect rules and standards no less than those required by the equivalent legislation and the International Seabed Authority's Mining Code).

8.4 Policy innovation for the transition to a green economy

Historically, the market-driven pathway to non-renewable resource development has greatly disadvantaged poor countries, which lack the financial and knowledge capital to manage the development of their natural assets (Daly and Farley 2011). The result has been, on occasion, the undervaluing of non-renewable resources by failing to account for the unavoidable long-term increase in scarcity and uncompensated ecological and social costs (Gowdy and McDaniel 1999: a case study from on-shore mining in the Pacific).

Deep sea minerals are one of several potential non-renewable resource prospects that offer an opportunity for both resource-endowed countries and the global community to apply transformative policies to ensure future resource development.

The decisions associated with potential deep sea mining are, of course, subject to political factors and indirect economic considerations. For example, international aid, diplomatic concerns, or other socio-political factors may ultimately sway the decision as to whether a country chooses to proceed with development.

As part of a green economic approach five policy design principles (based on Daly and Farley 2011) could be considered when evaluating potential development. These principles are not specific to deep sea mining. They are, rather, approaches to representing, monitoring, and accounting for global needs and local goals, while ensuring the integrity and health of priceless natural systems.

1. Economic policy does not involve one goal but many. Each goal must be addressed, sometimes by its own policy instrument and always in a coordinated way.

In a world defined by such challenges as poverty and inefficient use of raw materials, policies related to the production of minerals from deep sea mining must address each desired goal (for example, poverty reduction and increased efficient use). In the conventional paradigm, the debate is typically reduced to whether the inefficient use of raw materials, such as minerals, should be subsidized to lower their costs and help the poor or raw materials should be taxed to raise their price and promote efficient use. With a green economy approach, one would desire one or more policies that address both issues in a coordinated manner. For instance, a royalty system – developed to promote economically efficient use – would be coordinated with an income distribution system that would help to alleviate poverty. This is exactly the approach taken with proposed carbon taxes.

2. Because of the cumulative impacts of mining, policies should aim to establish the necessary degree of big-picture control, while maintaining critical flexibility to accommodate the need for activity-specific variability.

Mining (whether based on land or in the deep sea) has a net ecological cost. That is, a certain amount of habitat area is impacted. At the national scale, the limiting consideration is cost, in terms of lost ecosystem function and services (food provisioning, quality liveable space, clean water access, etc.) from a country's overall geographic space. This consideration would drive the development of a national policy instrument to limit total habitat impact or loss of ecosystem value, based on considering all mining activities in the country, possibly together with all major activities that affect habitat quality and ecosystem value. This big-picture limit can be implemented in a way that accommodates activity-level variability, such as one specific mining activity being more intense than another. However, the national-level control ensures, possibly through fiscal incentives and/or taxation penalties or other mechanisms, that national-scale environmental quality and ecosystem service value is preserved.

3. Policies should be developed with a generous margin of error when dealing with the biophysical environment and social systems.

When managing the impact of human activities on a natural system, there is a need to factor in the complexity of that system, as well as the usually high levels of uncertainty and, at times, the potential irreversibility of consequences and impacts. Leaving a considerable safety margin between demands on the natural and/or social systems and a best estimate of their capacities to withstand environmental damage is an advisable approach. Operating too near or at system capacity can lead to unexpected and unaffordable costs, manifested in ways that include reduced ecosystem function and usability and degraded societal structure and cohesion. Mining development should be designed to avoid areas of critical biological and ecosystem importance, minimize environmental impacts at every stage, and mitigate unavoidable environmental damage.

Muscat Cove, Fiji. Photo courtesy of Robert and Elyse Brown.

4. Policies should recognize that the starting point is always based on the current policy-making reality, build on existing good environmental and social policies that are effective, reform bad ones, and create new ones only when nothing good exists.

Regardless of whether desired outcomes are quite different from the current state of affairs, the latter is nonetheless the starting point of any policy process. Developing policy instruments focused on potential deep sea mining or, more broadly, on a transformation of the global raw-minerals cycle does not involve starting from a blank slate. Reshaping and transforming existing processes and/or institutions tends to be more effective than abolishing them. For many regions with no conventional mineral endowments, deep sea mining could offer an opportunity to develop and implement long-term policy designed to enable the investments needed for transition to a green economy. The transition could be accomplished most effectively by incorporating and adapting existing regulations, policy processes, and economic frameworks. The market economy and its institutions and processes are solidly present in our highly connected world. This paradigm cannot simply be ignored. However, the opportunity to affect the local-to-global mineral cycle in favour of a more frugal use chain could have a significant impact on the evolution of our economic model and social construct.

5. Policies should be adaptable in consideration of conditions and parameters that are likely to change.

Our world, as a whole, is defined by constant change, and policy should be developed with change in mind. Human impacts on the natural world are enormous. Over time, we are likely to cause new, unforeseen problems and perhaps identify opportunities to avoid other new problems. Ecosystems themselves show considerable variation over natural time scales, from seasons to eons. Natural systems are complex and non-linear. Their histories can be measured and described, but our ability to predict with any real accuracy the long-term effects of given actions is more limited. Although human systems operate in the same way, this is seldom acknowledged, in the hope that we can continue to rely on simple management models.

As society comes to terms with the challenges and opportunities of a reality defined by increasingly scarce natural resources, policy for the management of emerging unconventional resources, such as deep sea minerals, will need to adapt to rapidly changing social and ecological conditions and be responsive to longer-term goals defined by factors of ecological and social sustainability. With fewer and fewer raw mineral resources likely to be discovered, conventional or otherwise, the purpose we assign to their use needs to be tied to specific societal goals, achievable within the limits of actual physical systems, rather than left to the whims of a decoupled market.

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