Ocean and Coastal Management xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Ocean and Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

The Cook Islands (South Pacific) experience in governance of seabed manganese nodule mining

Michael G. Petterson[a,*], Akuila Tawake[b]

[a] School of Science, St Pauls Street, Auckland University of Technology, Auckland, New Zealand
[b] Geoscience and Maritime Division, Secretariat of the Pacific Community, Mead Road, Suva, Fiji

A B S T R A C T

The Cook Islands (CI), South Pacific, has one of the highest ratios of ocean to land area of any ocean island state in the world. Within it's EEZ exist abundant resources of seabed manganese nodules, thought to be the fourth richest resource of its type in the world, with a potential theoretical monetary value of c. $10 trillion US. The largely hydrogenetic nodules are rich in Ti, REE, Mn, Co and Ni. Economic studies suggest that a single twenty year-long mining operation could generate c. 150 jobs directly supporting 15% (c. $43M US) of the CI GDP. At least 18–46 similar mines could develop. This paper documents the history of CI seabed minerals governance from the 1960s to 2017 and draws key conclusions. Data is drawn from CI Government archives, CI media, and key stakeholder interviews. Findings are contextualised against Pacific Island economic& developmental challenges. CI was the first country to set up a National Seabed Minerals Authority, (CISMA), in 2012). CISMA was the culmination of development from the 1960s. CI developed of the world's first seabed minerals act in 2009, and a range of governance management tools, most recently with the creation of *'Marae Moana'* in 2017 (with a remit of holistic marine spatial management). The paper identifies a spectrum of stakeholder values and attitudes towards seabed mining, including anti-mining positions, and develops a motivation-values-outcome-mitigation matrix that asks key questions of responsible governance of a multi-billion dollar international industry *for national good.*

1. Introduction & purpose

This paper focuses on aspects of governance and management of seabed minerals. Cook Islands (CI) is presented as an example of a Pacific Small Island Developing State (PSIDS) that has progressed a range of governance tools and protocols to a mature level, particularly considering it's small population. The paper analyses aspects of context that have been key drivers for the development of seabed minerals governance. These include elements of the CI geography and geology, mineral prospectivity, and economic situation/future economic scenarios. These are the backdrop to understanding why Cook Islands focused on a futuristic industry, and invested significant resources into seabed minerals governance. There are numerous choices and options for governments. PSIDS options are less than for many countries. PSIDS resources are also limited and careful decision making is required to prioritise public sector resources. In this context deciding to become an early mover for seabed minerals governance may appear a surprising choice. The paper suggests what key drivers and conditions encouraged this choice to be made and describes the journey CI took as it progressed seabed minerals governance. The paper presents key challenges for CI and PSIDS in future seabed minerals management, particularly with respect to the power asymmetry manifested in the relationship between a small island economy and large powerful countries/corporations who have the resources to develop deep sea minerals.

1.1. Methodology

This paper results from a range of methods of research. The authors were key players within a seven year programme of work for 16 PSIDS countries that aimed to progress seabed minerals governance within the region. This project (the SPC-EU Deep Sea Minerals Project, Petterson & Tawake, 2016) generated numerous reports, workshops, reports of stakeholder interactions, and so forth and these data form a backdrop to this paper. Cook Islands was one of the countries involved in the SPC-EU project, and a country that progressed it's governance to a mature level. The author's progressed research from the SPC-EU project and undertook a two week mission to CI in 2017. This mission interviewed a number of key actors who have been involved at government and non-government levels in the development of seabed governance. The testimonies of these interviewees form a key data and informed opinion base for this paper. The mission also involved a close examination of media reports over a 40 year period: this is summarised and analysed in this paper. Finally, the authors have undertaken a comprehensive literature review with a focus on aspects of Cook Islands economy and demography and seabed minerals issues relevant to the research.

1.2. Generalised geography of Cook Islands

The Cook Islands (CI) is a self-governing small island developing

* Corresponding author.
E-mail address: michael.petterson@aut.ac.nz (M.G. Petterson).

https://doi.org/10.1016/j.ocecoaman.2018.09.010
Received 30 April 2018; Received in revised form 12 September 2018; Accepted 18 September 2018

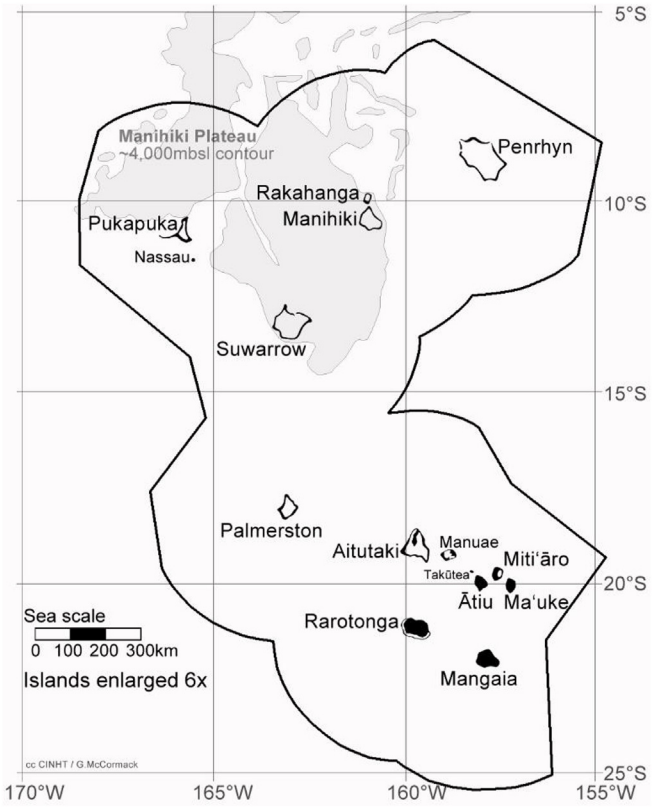

Fig. 1. Exclusive Economic Zone of Cook Islands showing the location of the Manihiki Plateau and the 15 Cook Islands. McCormack (2016).

state in the South Pacific region. It comprises 15 separate islands or island groups spread over an Exclusive Economic Zone (EEZ) of around 2 million km^2 (Fig. 1) Cook Islands EEZ is situated between latitudes 6° and 25° South and Longitudes 155° and 168° West. The islands of CI form two distinct groups: a northern group and a southern group. The southern group of nine islands are the most highly populated and include the islands of Rarotonga, Aitutaki, Mangaia and Atiu. The northern group of six islands include Manihiki, Pukapuka and Penrhyn. The total cumulative land area is 237 km^2 giving it an ocean/land area of c. 8440:1 making it a large Ocean Island State as well as a Pacific Small Island Developing State (PSIDS). Like all Small Island Developing States (SIDS), Cook Islands (CI) has a range of development challenges. A challenge many SIDS have relates to options for economic development and ability to earn income. This is particularly true of the smaller SIDS, of which CI is one. As shown above SIDS may also be termed Large Ocean States, with a governance responsibility for thousands or millions of square kilometres of ocean territory. The ocean presents development and environmental management challenges and CI, like all SIDS look towards their ocean surroundings for both. Fishing is the largest ocean-based economic activity for most SIDS. This paper will focus on a range of aspects of the development potential and challenges of another possible ocean resource: seabed minerals or Deep Sea Minerals (DSM).

1.3. Development challenges of Pacific Small Island Developing States

Readers are referred to (Petterson and Tawake, 2016; McGillivray et al., 2010) and references therein for a detailed analysis of the development situation of the Pacific Islands region. The subject is relevant to an understanding of why SIDS are interested in seabed minerals, but the details of development are beyond the scope of this paper. Pacific Small Island Developing States (PSIDS), whilst displaying a great deal of individual variation within the PSIDS category, have certain shared

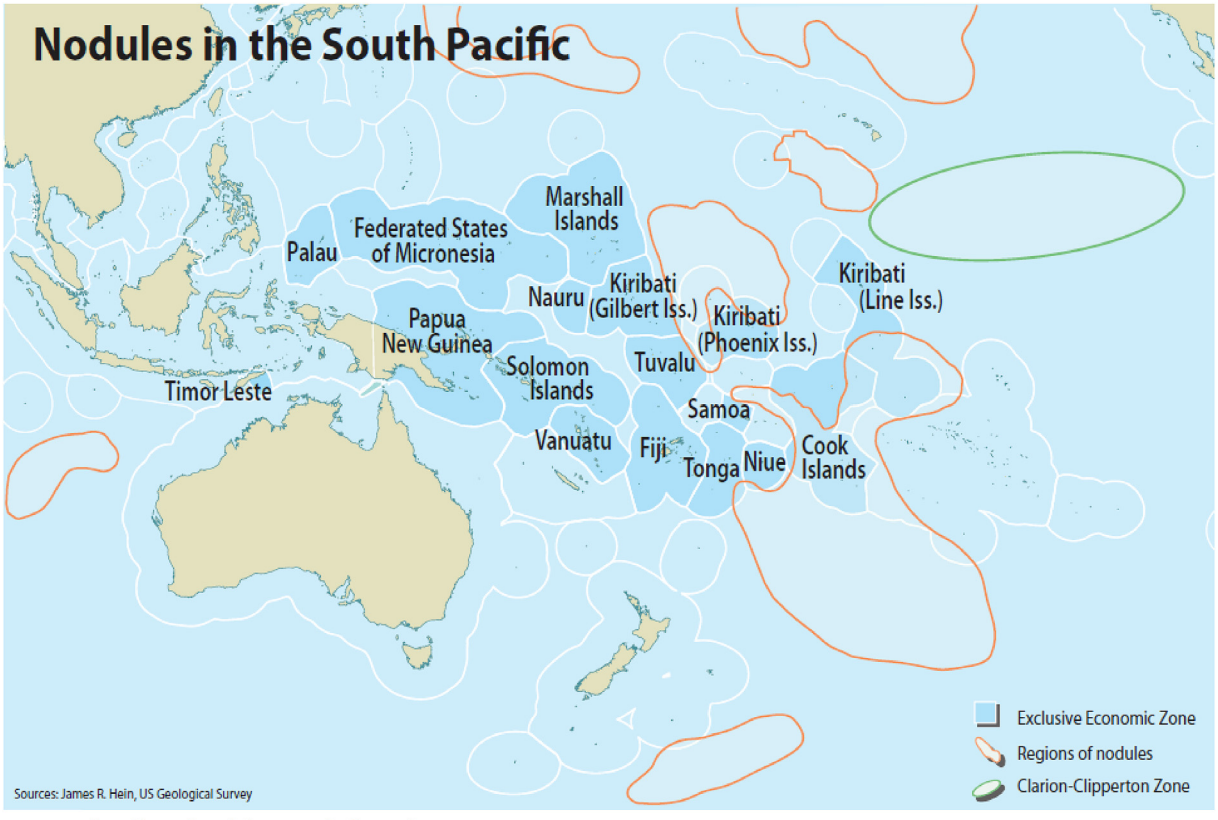

Fig. 2. Pacific Islands Region showing the exclusive economic zones of several Pacific Island states and the main locations of manganese nodules. SPC (2013).

characteristics that influence development. Papua New Guinea (PNG) will be omitted from this discussion as it has a relatively high population (> 8 million) and a large land area (c. 460,000 km^2, or about the same size as France, Ukraine, or Myanmar).

PSIDS are spread across an area of ocean approximately equivalent to the continent of Africa, or c. 300 million km^2 (Fig. 2). Fourteen PSIDS (omitting PNG) are independent or self-governing nations. The combined area of the PSIDS (omitting PNG) is c. 85,000 km^2 or equivalent in size to Azerbaijan, Austria or the United Arab Emirates. The larger PSIDS include Solomon Islands (28,400 km^2) Fiji (18,600 km^2) and Vanuatu (12,200 km^2) with the smallest PSIDS being Nauru (21 km^2) and Tuvalu (26 km^2). The combined population of the PSIDS (PNG omitted) is between 3 and 4 million with Fiji (860,000–900,000) and Solomon Islands (c.611,000) being the most populous and Nauru (c. 13,000) and Tuvalu (c. 11,000), being the least populated.

Some of the most fundamental challenges for PSIDS link directly to their geographical and geological setting, and their small size. Geographical isolation means that trade is inherently expensive and difficult. Small populations restrict the development of significant indigenous industry, as demand is limited and the costs of importing raw materials may be prohibitive. This results in a reliance on imported goods and a high export/import ratio. Many countries are archipelago nations with widely dispersed populations, making in-country transaction and supply costs high. It is difficult to offer a range of services to small widely dispersed populations. Atolls are particularly challenging environments with most land only 1–3 m above sea level, limited fresh water supplies, and a lack of agricultural land. PSIDS are highly vulnerable to natural hazards including cyclones, earthquakes, floods, tsunamis, landslides, storm surges, and volcanic eruptions. There is a negative correlation between economic development and natural disasters Petterson and Tawake, 2016). Two recent large magnitude examples include Cyclones Pam and Winston that affected large parts of Vanuatu and Fiji respectively in 2015 and 2016: the financial damage of Cyclone Pam was estimated to be equivalent to c. two thirds of the GDP of Vanuatu (World Bank, 2015).

Many PSIDS experience similar economic and social realities. Opportunities for wealth generation focus largely on agriculture, fisheries, and tourism. Forestry, logging and mining are important for countries such as Solomon Islands, Fiji and Vanuatu. Fiji has developed a limited number of local industrial and manufacturing industries, but this is unusual. Tourism is particularly well developed in Fiji, Cook Islands, Vanuatu, and French Polynesia. The availability of high quality education and health services is variable. Emigration and the loss of highly skilled people is common for many SIDS. Urbanisation is progressing fast, particularly among Polynesian countries, with high ratios of urban: rural populations. Many outer islands and remote provinces are increasingly de-populated, particularly of younger people. Traditional subsistence lifestyles are common, particularly in Melanesia, or the outer islands of Micronesia, but the cash economy has made large inroads into most areas of Pacific life.

GDP/Capita varies between $36,000 US (New Caledonia) and $1600–1700 US (Kiribati, Solomon Islands). Most independent PSIDS having a GDP/Head of between $1600 and c. $5000US. PSIDS export half of all exports to only three countries (Australia, Japan and China) with Australia taking one third of all Pacific Island exports. The level of aid to the Pacific is high, equivalent, on average to c. 23% of the GDP, and, for some countries, this proportion is much higher. Private remittances are important for some PSIDS economies. Several PSIDS regularly fall into the 'Low Income Country Under Stress' category of the World Bank which emphasises the fragility and vulnerability of many PSIDS economies. Many PSIDS are suffering from non-communicable diseases leading to high incidences of obesity, diabetes and heart disease, which, in turn, raises morbidity and acute illness rates, and reduces the effectiveness of the work force.

1.4. Cook Islands economic situation and outlook: driver for seabed minerals

The previous section presented macro-economic, social and geographical development challenges for the Pacific region. One key driver for many PSIDS is economic diversity (Guillaumont, 2010). The challenge for many PSIDS is developing a range of viable economic options. CI has some particular challenges with respect to economic diversity, and there is a desire to become less dependent on New Zealand and external aid. This section examines the characteristics of the CI economy with a view to finding reasons why the CI decided to invest resources in seabed governance, and investigate how much revenue seabed minerals could realistically add as a proportion of the overall CI Gross Domestic Product (GDP). Data for this section is derived from: 1) the Cook Islands Government Ministry of Finance and Economic Management (2017 website); 2) Population census 2011 data (Cook Islands Government); ADB (2017); Bertram (2016); UNDATA (2017); CIA World Fact Book (2017); and World Bank (2015,2016), SPC (2012).

The resident population of Cook Islands was estimated at c. 15,000 by the 2011 Census (Cook Islands Government, 2011). It is estimated that c. 90,000 people of Cook Island descent live outside of CI. Education levels, particularly amongst the older demographic are low. Approximately 10% of Cook Islanders attend Tertiary education and 76% have no trade or professional qualifications. The unemployment level was at 8.2% in 2011 and a similar level in 2016. Demographic statistics show a relative contraction in numbers of people aged 20–40 years old, reflecting a migration trend. Cook Islanders have New Zealand passports and the right to work in New Zealand.

The CI economy comprises largely of tourism, fisheries, agriculture, pearl farming, small scale manufacturing, and a relatively small subsistence economy. Tourism is by far the largest economic sector. Annual visitor numbers to CI are between 120,000 and 150,000 people per year giving CI the highest tourist/resident ratio in the Pacific Islands region (between 4:1 and 6:1). (CI Government accounts, www.mfem.gov.ck (2016). Tourism employs c. 35% of the CI workforce and is worth 50–60% of the CI GDP. In total, the service sector, mostly linked to tourism or government, comprises 82% of CI GDP (Fig. 3). Industry comprises 13% and agriculture 5% of the CI GDP respectively. Fishery receipts are between $5M NZ and $19M NZ per year and pearl exports are valued at c. $0.15–0.4M to a maximum of $1M per year.

For the recent historical period the economy of Cook Islands has been growing. Much of the economy is based around tourism. Tourism has already become a mature market. Tourism could grow further, e.g. by attracting high-end market clients for remote locations, but it is unlikely to grow dramatically. The CI Government is currently investing in infrastructure to sustain tourism and environment. Fishing may have capacity for growth: perhaps a factor of 2–3 times present annual income (c. $15M NZ). The pearl industry is unlikely to grow significantly. Agricultural income could grow modestly in areas such as tropical fruits and cosmetic/health value-added products. Cottage industries, can make an additional contribution to the CI economy. A new fast-speed fibre-optic ocean cable will connect CI with the global broadband communications network, which could attract e-industry.

In 2016 the Cook Islands GDP was $282 Million US, giving a GDP/Capita value of c. $15,000 to $17,000 US depending on the figure used for a permanent residential population (Fig. 3). The Asian Development Bank (ADB, 2017), record that Cook Islands has achieved six consecutive years of economic growth since 2011. Recent OECD (Organisation for Economic Co-operation and Development) assessments of the Cook Islands economy will lead to a re-categorisation of Cook Islands as a 'Developed State' by the end of 2018, Bertram (2016). Bertram (2016) undertakes a detailed analysis of what this change will mean for a PSIDS like Cook Islands and concludes that it may only have a marginal impact on the CI economy. A 'Developed Status' will make Cook Islands ineligible for certain developmental assistance, The close association with New Zealand, Australia, and others, (e.g. the EU) is likely to

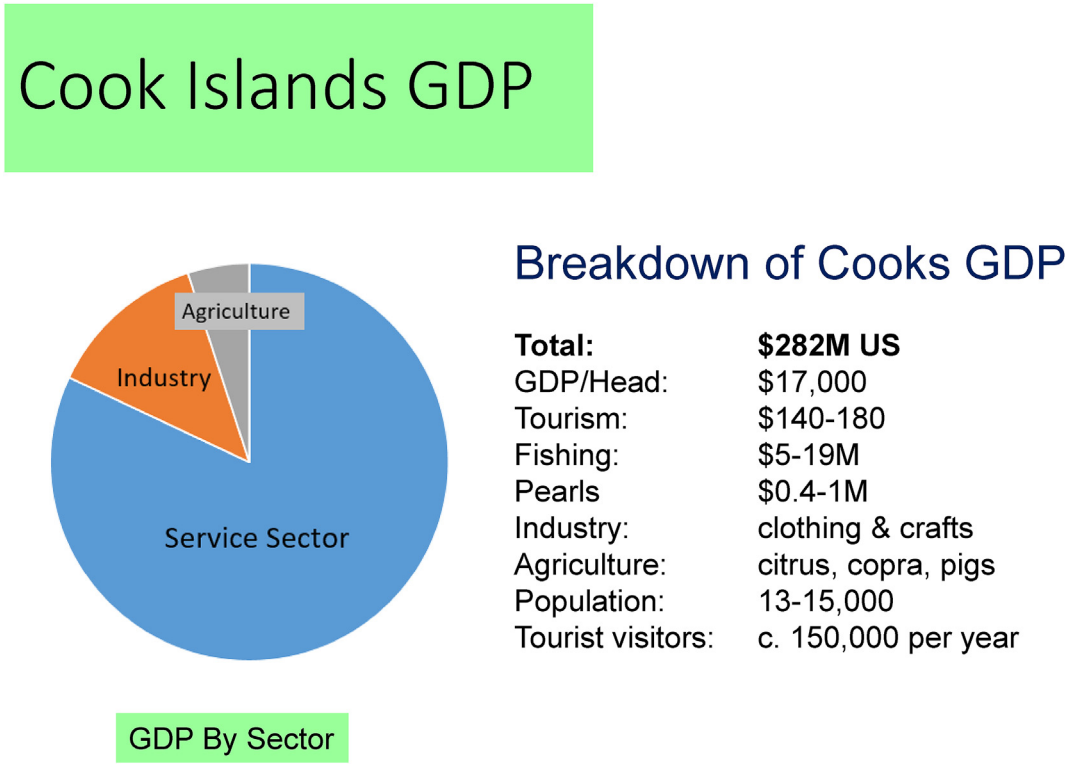

Fig. 3. Aspects of the Cook Islands gross Domestic product (data from Cook Islands government statistics).

remain unaffected. At present CI receives c. $25 Million NZ from New Zealand annually (CI Government accounts, www.mfem.gov.ck, 2016). The 'Developed State' status could have a positive impact on foreign investment in CI, including seabed mining investment. There is a question regarding economic vulnerability of SIDS as they graduate to a 'Developed Country status' as a lack of economic diversity, geographical remoteness, and susceptibility to natural disasters, can adversely affect economies (Guillaumont, 2010).

This economic analysis points towards a number of 'influencers'/drivers re seabed minerals. Although the CI could become a Developed State, CIG is conscious of a high reliance on tourism and continued New Zealand assistance. There are few options beyond tourism and fishing for growing or even sustaining the present economic relative prosperity. Seabed Minerals presents itself as another option, worthy of exploration. Although an industry of the future, CI could develop a competitive advantage through seabed mining governance development.

2. Deep sea minerals and the Pacific Islands region

Minerals can only be worked where they are located. CI can only gain resources from mining if resources are present within the EEZ, and can be mined economically. A range of seabed minerals are present in the Pacific region.

Three main types of seabed mineral are present in the Pacific Islands region. Polymetallic Sulphide deposits form through hydrothermal activity in active tectonic settings such as volcanic arcs, back-arcs and Mid-Ocean Ridges. They are particularly rich in the metals copper, lead, zinc, gold and silver, (Hannington et al., 2005, 2010, 2011). Polymetallic sulphides occur at depths of between c. 1000 and 4000 m beneath sea level. Within the Pacific Islands region polymetallic sulphides are most abundant within the Exclusive Economic Zones (EEZs) of Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Tonga, and New Zealand. Polymetallic sulphides are unknown within the Cook Islands EEZ. Cobalt Rich Crusts (CRC's) form on sediment-free rock surfaces within the ocean, forming layers up to 26 cm thick. CRC's form from chemical precipitation from seawater, at water depths of between 600 and 7000 m deep, on the flanks of seamounts and undersea volcanoes, plateaux and similar topographic features, with a height of 1000 m above the ocean floor (SPC, 2013a). CRC's contain elements such as cobalt, nickel, copper, tellurium, platinum, zirconium, niobium, tungsten and rare earths. Most CRC's of economic interest are between 800 and 2500 m depth (Hein et al., 2013, Hein and Koschinsky, 2014). Yesson at al. (2011) and Beaulieu (2010) estimate that there are around 11000 seamounts in the Pacific Ocean. CRC's are particularly abundant close to the Federated States of Micronesia, Marshall Islands, Kiribati, Tuvalu, Cook Islands, and French Polynesia.

Polymetallic Manganese Nodules (MN) are the main subject of this paper. They form at depths more than 4000 m and up to c. 6500 m, from cold seawater (hydrogenetic nodules) or from ocean floor sediment pore waters (diagenetic nodules), e.g. (Hein et al., 2015). Precipitation occurs concentrically around a pre-existing nucleus (e.g. a shark's tooth/lithic fragment) and accretes at a rate of c. 1–10 mm per million years (hydrogenetic nodules) or 1–300 mm per year (diagenetic nodules). Most nodules are 4–14 cm in diameter, and vary in shape from spheroidal/sub-spheroidal to nodular/cauliflower-like/irregular. MNs contain cobalt, copper, nickel, rare earths, molybdenum, lithium and yttrium. MNs are largely present within the EEZs of Kiribati, Cook Islands and French Polynesia (Fig. 4). One area of particular note is the Clarion Clipperton Zone (CCZ) in the Eastern-North- Pacific, which extends over a distance of c. 3000 km and is the region of highest abundance for MN known on earth (Fig. 4). The CCZ is within international waters and contains the highest density of seabed mineral exploration licences on earth. The CI EEZ contains the fourth richest resource of Manganese Nodules on earth (the first three being the CCZ, the Peru Basin (in the Pacific Ocean west of Peru and Chile) and the Central Indian Ocean region). CI nodules are largely of hydrogenetic origin and constitute the largest and richest Manganese Nodule resource within an EEZ on earth (Fig. 5).

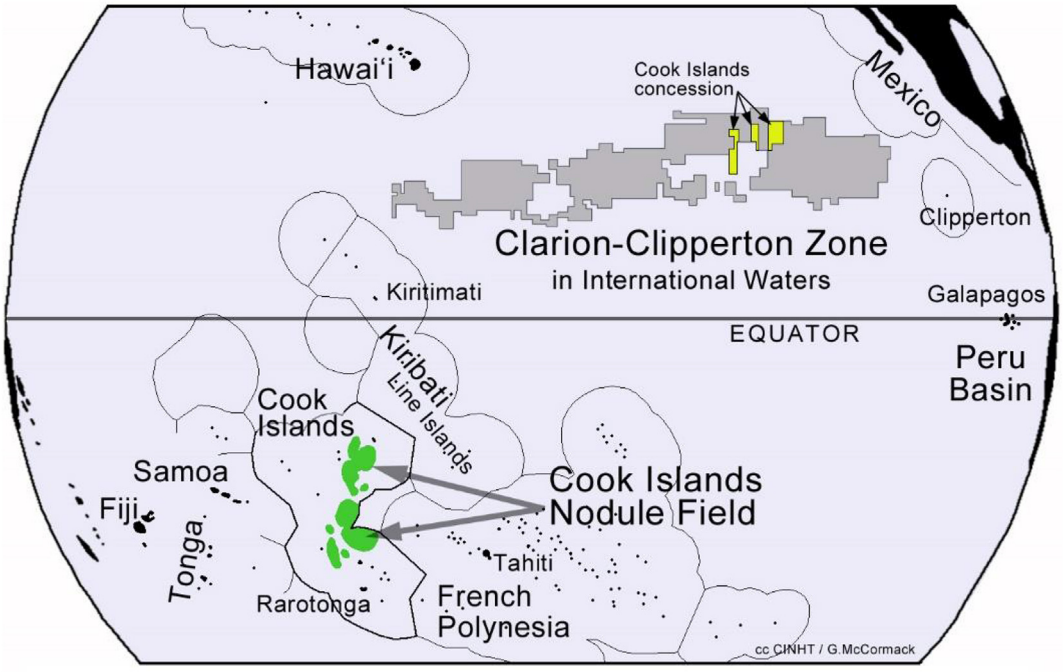

Fig. 4. Context map showing the Cook Islands manganese nodule fields in relation to neighbouring countries and the Clarion Clipperton Zone. McCormack (2016).

2.1. Geological & mineral deposit architecture of the Cook Islands EEZ

Fig. 6 summarises the topography of the CI EEZ. The northern CI EEZ is dominated by the largely-submarine Manihiki Plateaux. The Manihiki Plateaux is predominantly Cretaceous in age (c. 125-116 Ma) with some younger components (c. 100-60 Ma) and comprises a series of large-volume basaltic lavas, some 15–25 km, thick over an area of c. 770,000 km^2. The Plateau mostly reaches up to 2500–3000 m below sea level, with the highest parts forming the northern Cook Islands (Pietsch and Uenzelmann, 2015). Plateau geomorphology is formed of three main sub-plateau (x). The western plateaux are partly within the CI EEZ. The eastern and western Plateaux are separated by a rift valley oriented NNE-SSW, east of Pukapuka and west of Suwarrow. The Manihiki Plateaux is important from a number of points of view in terms of seabed minerals, and the extent of the CI extended Continental Shelf. The Antarctic Bottom Water is a dense, cold current that occupies the deeper parts of the southern hemisphere ocean basins that have a connection with the Southern Ocean. Surface waters around Antarctica become enriched in salt and oxygen and so cold/dense that they sink down to become the northward flowing Antarctic Bottom Water (AABW) (McCormack, 2016). The AABW divides within the CI EEZ as it flows around the Manihiki Plateaux. The AABW flows towards the west through the rift valley and along the southern and western edges of the plateau. The AABW also flows within the deep Penrhyn Basin: this flow is a causal factor for the formation of a rich manganese nodule field within the Penrhyn Basin (Cronan et al., 1991). The Manihiki Plateaux, being an upraised plateaux, could also be a source for CRC mineralisation. The UN Convention on the Law of the Sea (UNCLOS) allows

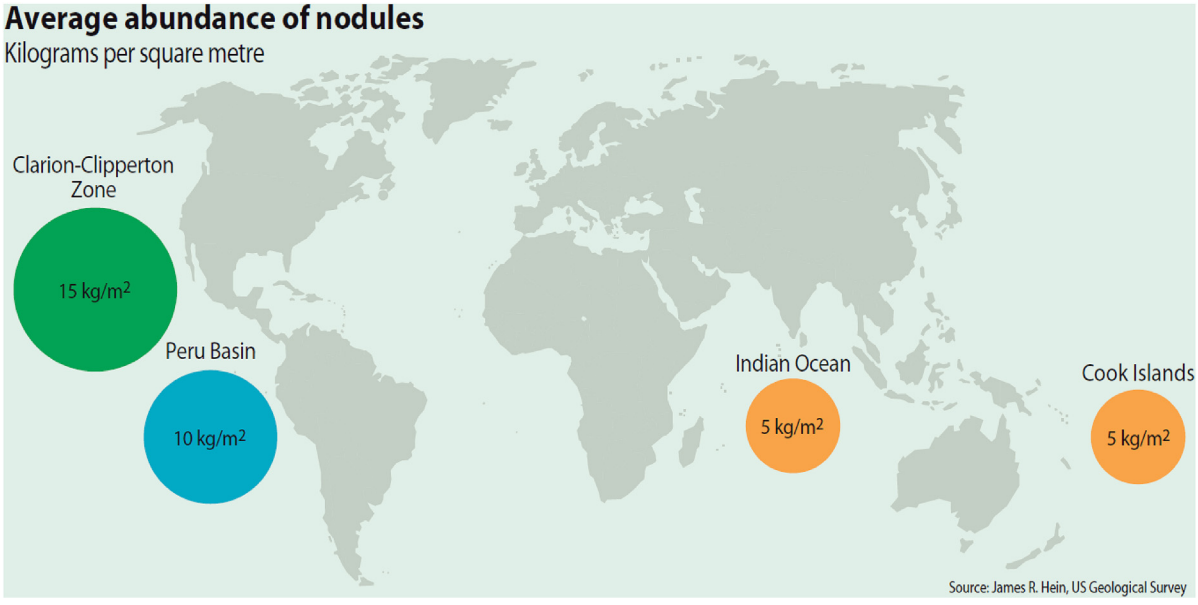

Fig. 5. Average global abundance of manganese nodules. SPC (2013).

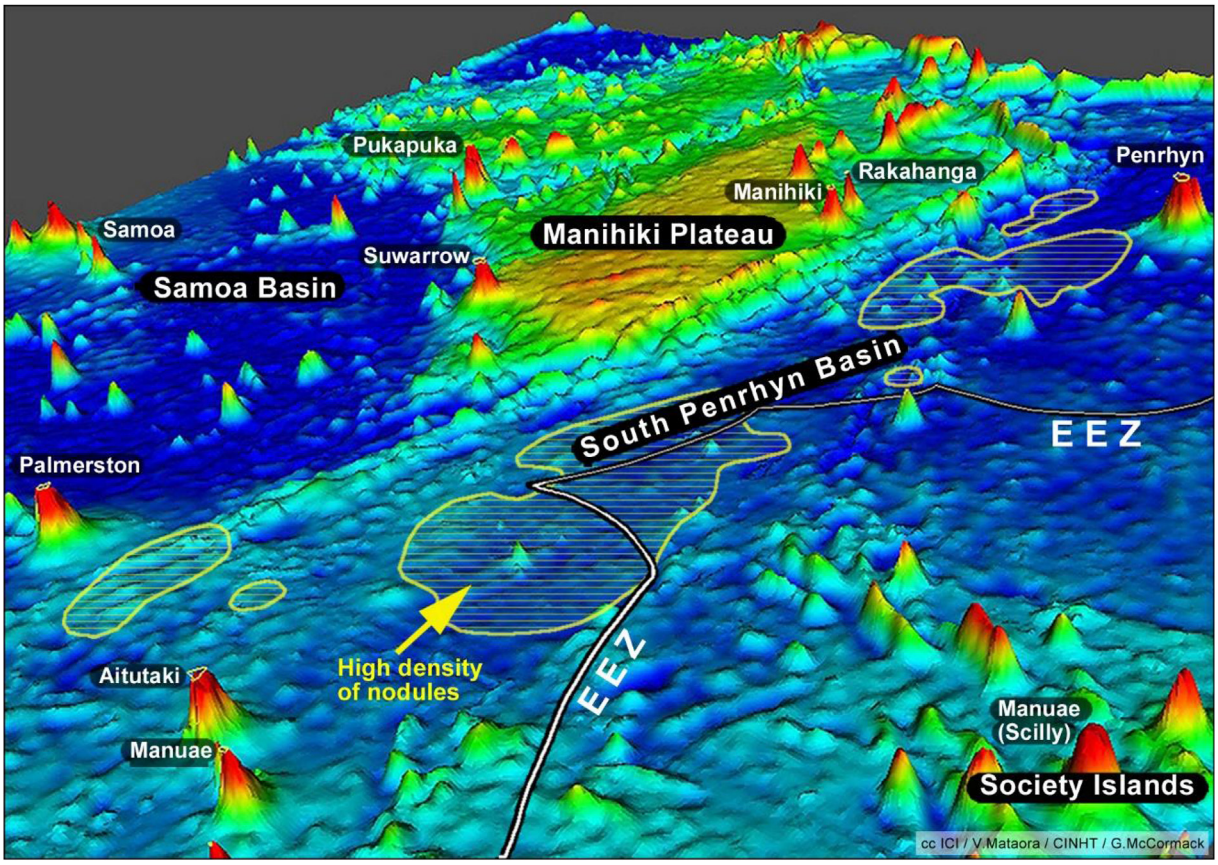

Fig. 6. Three Dimensional image of the topography of the Cook Islands EEZ ocean floor. McCormack (2016).

for extensions to the EEZ based on geological arguments. CI has submitted a claim for over 400,000 km^2 of additional territory. There are two ocean basins within the CI EEZ where the deepest ocean depths are recorded. The Samoa Basin, to the south of the Manihiki Plateau, and the north-south oriented Penrhyn Basin (Fig. 6). MNs form within the deeper parts of the CI EEZ, particularly within the Penrhyn basin.

2.2. Distribution and character of manganese nodules in the CI EEZ

Seabed mineral exploration within the CI-EEZ began in the 1960s. The 1970s surveys resulted in the discovery of significant MN resources. Surveys from 1985 to 2000s by the Japan-SOPAC Cooperative Study delivered a range of data and models including a systematic survey of much of the CI-EEZ. In total there have been over 20 scientific research cruises within CI waters (SPC, 2014). The Japan-SOPAC study yielded a wealth of systematic data that has been re-synthesised and re-assessed by the Cook Islands Seabed Authority since 2012. A comprehensive database/GIS of CI seabed minerals data is available (http://www.seabedmineralsauthority.gov.ck). Further research and reviews resulted key publications such as (Hein et al., 2015; Cronan, 2013, SPC, 2013, 2014).

CI MNs occur predominantly within the Penrhyn abyssal plain. CI nodules are primarily hydrogenetic in origin. Nodules are mainly spherical or sub-spherical, flat or irregular in shape. MNs are largely between 8 and 80 mm in diameter, with manganese and iron oxides/hydroxides accreting in a concentric fashion around a nucleus. The largest nodules are 14–18 Ma, and are zoned with a nucleus plus core region, a thicker central 'mantle region' and an outermost thinner layer. CI nodules are particularly rich in cobalt, nickel, titanium, yttrium, and rare earths as well as molybdenum, niobium, vanadium, tungsten and zirconium (Hein et al., 2015). A zone of high nodule abundance exists, oriented N-S within the Penrhyn basin, and bifurcates towards the SW and SE in the southern part of the EEZ, (Fig. 7). Nodule abundances are up to 58 kg/m^2, with large areas of the seafloor exhibiting nodule abundances in excess of 25 kg/m^2 (over an area of c. 124,000km2, or a little less than the area of England or Nepal).

2.3. Economic value of Cook Islands manganese nodules and mining scenarios

Hein et al. (2015) address a number of key issues that relate to the value and potential mining style of CI nodules. These data and analysis are summarised in Table 1. The CI nodule fields are the most abundant nodule fields extending over the largest area known on earth (124,000 km^2). The Clarion Clipperton Zone (CCZ) is the largest overall resource on earth extending over an area of over 1.1 million km^2, but nodule abundances are lower with respect to the CI. Hein et al. (2015) estimated that one ton of CI nodules is worth c. $1111 US in terms of elements such as Mn, Co, Ti, Ni and REE. Some 2.6 billion tons of nodules are present within the enriched MN fields, which equates to a theoretical value of c. $2.9 trillion US dollars. Some 8.9 billion tons of nodules are present within the whole CI-EEZ area, with a total value of c. 10 trillion US dollars. For comparison, the current GDP of the USA is around 19 trillion US dollars, and that of the world c. 78 trillion US dollars (IMF World Economic Outlook, April 2017). Cronan (2013) estimated that the CI EEZ contained a total of 11.3 billion tons (10.3 billion metric tonnes) which would give a total theoretical value of c. 12.7 Trillion US dollars (Table 1).

Hein et al. (2015) undertook a number of calculations concerning 'realistic' mining rates and tonnages per year (Table 1). For a mine with a 20-year-life, mining 2.5 million tons of nodules per year, (50 million tons over a 20 year period) a mine area would equate to between 135 and 336 km^2 per year or 2700–6700 km^2 over a 20 year period. The area of highest nodule abundance could therefore support 18–46

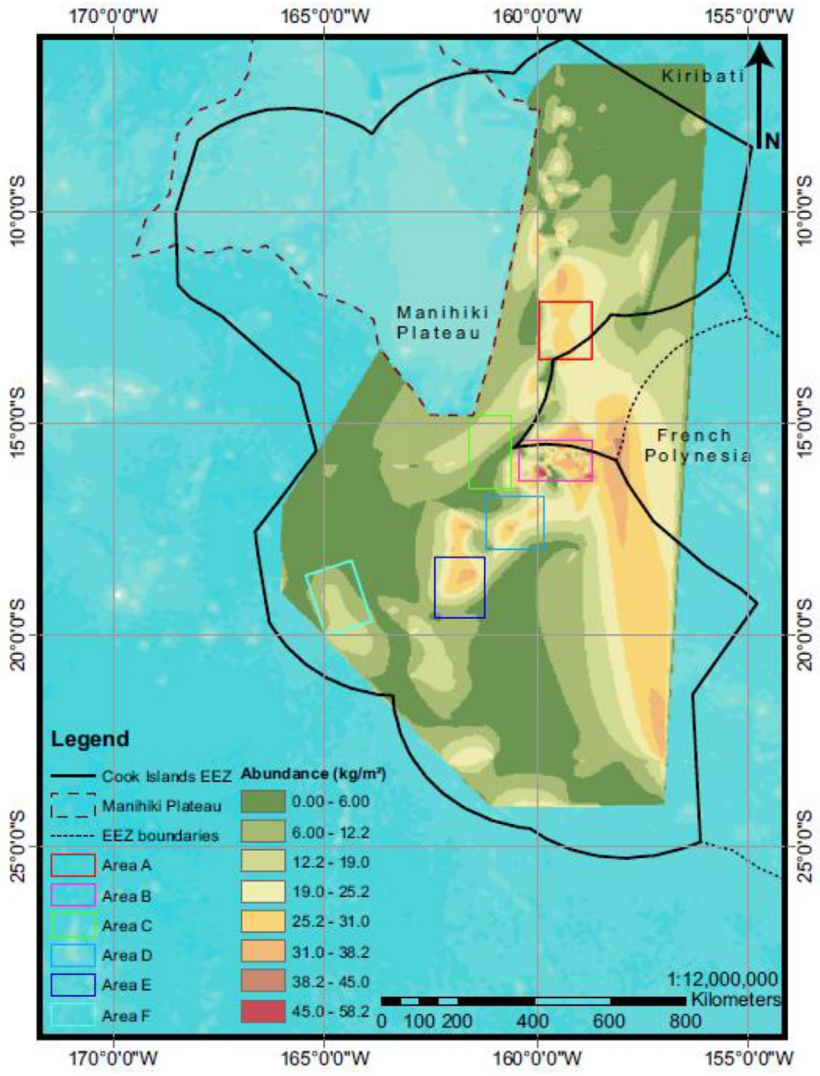

Fig. 7. Distribution and abundance of manganese nodules within the Cook Islands EEZ. Hein et al. (2015).

Table 1
Summary of estimates and modelling relating to the value of Cook Islands manganese nodules, aspects relating to a 20 year deep sea mine, and a cost benefit analysis of one 20-year long mining operation. Reference: Hein et al. (2015); SPC (2016).

Economics of Cook Islands Manganese Nodule Resource	
Metals present within nodules	Co, Ni, Ti, Y, REE, Nb, Mo, V, Zr, W
Nodule abundance	Highest grades are 25–58 kg/m^2 over 124,000 km^2 (similar area to Eritrea, N Korea, Greece)
Value of highest grade resource	$2.9 trillion US dollars
Total value of nodules within CI EEZ	$10–13 trillion US (USA GDP = $19 trillion)
Modelled Mine Estimates	
Mine life	20 years
Rate of mining	2.5 million US tons/year
Total production	50 million US tons (value = $ 55.5 billion)
Area mined per year	135–336 km^2
Total area mined for 20 year mine life	2700–6700 km^2
No of mines supported by highest grade area	c. 18-46
Total number of mine years	360–920 years of potential mining
Cost Benefit Analysis from Cook Islands Government perspective	
Revenue based on which metals?	Mn, Co, Ni, Cu, Ti, REE
Mine Parameters	20 year mine life, mining 50M metric tonnes, mining an area of 2705 km^2
External costs included	Seabed environment, accidental spills and releases, CO2 offsets, mining related sea water movements,
Cook Island Government costs	Mainly Administration
No of Cook Islander jobs	147
Total addition to GDP per year	$43.2M US per year
Funding derived from	Mostly taxes and royalties with some additional service related income
References	
Value of resource & modelled mine estimates	Hein et al. (2015)
Cost Benefit analysis	*Cardno* published as SPC (2016)

individual mining operations, each lasting 18–20 years. In reality, CI would choose to control/limit the number of mines to mitigate market over-supply issues and minimise adverse environmental/social impacts. These calculations are only a guide to the potential value of the CI deposits. Variables such as commodity price variability, commodity demand, ocean topography, weather conditions, mining costs, environmental and social management costs, and so forth, could all affect the potential resource value. The main message is clear: there is a huge potential metal resource present within the CI EEZ.

The SPC-EU-Deep Sea Minerals project commissioned the company *Cardno* to undertake an independent cost benefit analysis of three different types of seabed mining in the Pacific Islands region (SPC, 2016). One case study examined by *Cardno* was the mining of MNs within Cook Islands. Key results of this analysis are summarised in Table 1. The study focused on a 21-year-long mining operation, that mined a 2705 km^2 area, with high nodule abundance, with a total resource extracted of 50 million dry metric tonnes. Grades and market prices were estimated for the commodities Mn, Co, Ni, Cu, Ti, and REE. External costs such as managing seabed ecosystems, offsetting CO2 emissions, managing sea-water movements within the mining process, and cleaning up any unplanned negative environmental impacts such as oil spills, or release of toxic pollution, were accounted for. Internal government administration costs were included in the analysis. *Cardno* concluded that most benefit accruals would be derived from taxes/royalties. Estimated costs to Cook Island citizens are small relative to government revenues. In-country metal processing and refining is not an economic proposition. An estimated 147 Cook Islander jobs would be created from one mining operation. Approximately $2.4M US of income per year would accrue for local workers, and a further $1M US would result from support services and spending. In total, it is estimated that one mining operation would support $43.2M US of the GDP annually (some 15% of the current GDP and a significantly more substantial contribution than all non-tourism related economic activities). Two scenarios were modelled in terms of possibilities for managing mining revenues. Scenario 1 assumes that the CIG adopts a revenue sharing plan similar to the Norwegian Petroleum Fund. 75% of revenues would be banked under a Cook Islands Sovereign Wealth Fund, and 25% would be spent, divided equally, amongst the areas of health, education and infrastructure. Scenario 2 involves distributing the 25% non-Sovereign Wealth fund monies to all Cook Islands residents, with the residents spending these funds on goods and services. Scenario 1 would result in targeted investments in three critical areas of the country equivalent to $3.9M US per area per year. Scenario 2 would lead to a wider and less tangible spread of benefits equivalent to $11.8M per year.

3. Development of Cook Islands seabed minerals governance

A number of positive conditions exist for Cook Islands with respect to seabed minerals. Research demonstrates (above sections) that potentially valuable and voluminous MNs exist within the CI-EEZ. Seabed minerals within an EEZ could prove attractive to some mining companies, as they would deal with one Sovereign Government. The main advantage is the potential relationship with the government and people of the country. Mining companies value stable relationships and stable contractual conditions (Petterson, 2008). If a national government can offer this level of stability over time and demonstrate they have capable administrative and governance capacity the attractiveness to mining companies increases. The longer-term governance objective, in addition to competitive advantage to mining companies, is to realise mineral wealth for national good.

3.1. A governance history of seabed minerals administration in Cook Islands

A fundamental principle of sustainable development, particularly when applied to natural resource industries, is the quality of governance. Observations of mining practice across the world indicate that best practice mining occurs within jurisdictions with strong, accountable, and stable government, that have passed mining-specific laws, policies and regulations, and developed an appropriate mining-focused bureaucratic capability (Petterson, 2008). Indeed, high-quality mining companies are particularly attracted to jurisdictions that have strong mining governance with clear policies rules and regulations for the administration of mining practice (Petterson, 2008). It can be argued that even 'Blue Chip' extraction companies behave in a more sustainable manner in well regulated countries compared to the same company's behaviour in less regulated countries (e.g. compare the behaviour of the oil company Shell in Nigeria compared to its European operations, Pigrau, 2013).

Strong, focused-governance is particularly important for situations of gross power asymmetry. Mining companies have market capitalisation values, greatly in excess of many country's annual GDP, and can draw upon global resources for legal and negotiation purposes. In comparison, small states lack the human and capital resources required to negotiate with industrial giants. As an example, the oil company Shell had a market capitalisation value of $185 Billion US in December 2016 on the London Stock Exchange (FTSE, 2017): similar to the national GDPs of countries such as Finland, Peru, Vietnam and Portugal, greater than the GDP of New Zealand and the Czech Republic, and significantly greater than the less developed countries. The world's largest mining companies are worth between $80 and $93 billion US, with the top 50 companies worth a combined wealth of $842 Billion US (Elks, 2017). As a small island state the Cook Islands will have significant power-asymmetry issues with mining companies. Phillips (2017) discusses a range of power asymmetries and their meanings including political, economic and social power asymmetries. The basic concept is that where a situation exists of gross imbalance between two partners within a contracted situation, benefits will disproportionately accrue to the more powerful partner, and the powerful partner can strongly influence, or even set, the rules of engagement between two parties. Phillips uses the example of the company *Apple* to illustrate the principles. *Apple* operates across the world, particularly in East Asia, and production of *Apple* products includes thousands of sub-contracting relationships. *Apple* has become the world's first one Trillion US dollar company (Financial Times, 2018). This massive economic power base allows the company to influence rules of engagement across the world. *Apple* retains c. 59% of production value chain as company profit. The second highest profit benefactor (other than cost of materials) is 4.7% (work for *Apple* in South Korea that stays in South Korea). There are parallels here with a micro-state CIG negotiating with mining companies that have high levels of self-acquired capitalisation (Elks, 2017) or are state supported/sponsored via Superpower/Large-power countries such as China, USA, Russia, South Korea, Japan, Germany, UK and so forth. There are other power asymmetries to consider, such as social power asymmetries between Indigenous Communities and government/company. CIG will have the challenge of addressing such power relationships in negotiations both with external companies/countries and landowner indigenous communities/stakeholders within CI.

CIG perceptions of challenging circumstances linked with mining in other Pacific Island countries provide additional incentives to develop seabed mining legislation sooner, rather than later (e.g. Nauru, Christmas Island, Kiribati, and Bougainville in PNG, Petterson, 2008, Gale, 2016). These examples provide a window into the darker side of 'less well managed' mining. Bougainville is an example of significant mining-caused environmental damage, and mining as a causal factor in social unrest and war. Nauru and Christmas Island provide examples of mining related environmental damage, and severe social disturbance, caused by the rapid generation and abundance of insufficiently controlled mineral wealth (Gale, 2016). Numerous discussions Petterson had with CIG stakeholders (Table 5) alluded to these types of mining experiences as drivers for ensuring the development of robust CIG seabed mining governance.

The history of governance development within CI is an instructive case history, particularly remarkable for the relative small size of CI. This section presents a summary of key 'milestones' in the evolution of CI seabed minerals governance. Sources of data are from the Cook Islands Seabed Minerals Authority (CISMA), the Cook Islands News (a national newspaper), and press releases from the Cook Islands government.

Seabed minerals, as an issue, has been in the consciousness of the CIG from as early as 1965, with the appointment of Albert Henry as the first Prime Minister. Awareness increased in the 1970s, with the coming of oceanographic research ships to Cook Islands waters. Of significant note was the Soviet Research Vessel *Vityaz,* which collected MNs and invited Cook Islander Tom Marsters on-board. Marsters became a future Deputy Prime Minister and Queens Representative in Cook Islands, and a strong advocate for seabed minerals. The evolution of the United Nations Convention on the Law of the Sea (UNCLOS) between 1982 and final ratification, in 1994, led to the formal creation of the Cook Islands Exclusive Economic Zone (EEZ) as an internationally agreed national boundary (final EEZ agreed geographical coordinates were deposited with the United Nations in 2014). The emergence of a large area of territorial waters (some 2 million km^2, or approximately the same area as Saudi Arabia, Indonesia or Mexico) within the national administration of Cook Islands, increased the priority of ocean resources. Oceanographic exploration programmes included sufficiently data within CI waters to give an accurate indication of the composition, grade, size, and geographical distribution of the MN resource. The International Seabed Authority (ISA) was created in 1994, with the mandate of executing the legal implications of UNCLOS 3 within the international (non-EEZ) seabed area (i.e. Area Beyond National Jurisdiction), common known as 'the Area'. From the early 2000s the ISA began granting prospecting and exploration licences, largely within the Clarion-Clipperton Zone. In 1997 Papua New Guinea granted the world's first seabed minerals exploration license to Nautilus Minerals.

During the first decade of the 21st Century Cook Islands Government was approached by the Canadian banking group *Endeavour* with offers of c. $25M US for exclusive rights to exploration of parts of the CI EEZ. This stimulated an intensive debate in government as to whether or not to accept the *Endeavour* bid, or seek other ways to manage seabed mining. The consensus view prevailed that CI was not yet ready to make informed decisions, and that this situation required rectification.

In 2009 CI approved the world's first *Seabed Minerals Act.* The act was drafted as a collaboration between the CIG and the Commonwealth Secretariat. CIG debated how Government could best administer the new act, and develop seabed mineral resources. In 2011 Papua New Guinea granted the world's first seabed mining license within EEZ waters to Nautilus Minerals. On 26th June 2012 the Cook Islands Seabed Minerals Authority (CISMA) was established: a world first as a governance unit specifically focussing on seabed minerals and mining. The CI Seabed Minerals Commissioner was appointed in August 2012 (Mr Paul Lynch) and CISMA gradually employed staff with technical and administrative expertise in geology, geospatial science, administration, and law. The key purpose of CISMA is to *'develop and mature the Seabed Minerals sector of the Cook Islands in order to maximise the benefit of national seabed minerals resources for the Cook Islands people and investment and development partners, while also taking into account social and environmental considerations'* (CISMA website/Vision and Strategic Objectives).

To date CISMA has produced a range of governance and scientific tools/documents, including publication of: a reappraisal/synthesis of CI seabed mineral resources; the CI Seabed Policy (2014); the CI Prospecting and Exploration Regulations (2015); and the Seabed Minerals Amendment Act (2015). In mid-2015, CIG released an official tender for exploration and prospecting licences within specified parts of the EEZ. Although no serious applications were received during the tender phase, there were expressions of interest from Japan, Korea, China, Germany, UK and USA.

CISMA attracted active interest in exploration through the granting of an exploration license from the ISA, in partnership with Belgian company *G-Tec-Sea Minerals Resources* (GSR). Part of UNCLOS 3 states that any work within International Waters must be for the common heritage of mankind. One practical aspect of this principle is to develop partnerships between Developed countries/companies (who may have the wealth and inclination to create the required technologies for seabed mining) and 'Developing Countries'. To date there are a number of such partnerships between companies and Pacific countries, such as Nauru and Tonga. CI formed the company, *Cook Islands Investment Corporation*, as the entity to partner with the Belgian company GSR. GSR are actively exploring over their license areas within the Clarion Clipperton Zone. Similarly, Kiribati has established a state-owned-enterprise, Marawa Research and Exploration Ltd, that secured exploration licenses at specific sites within the Clarion Clipperton Zone.

CIG passed an act to bring the Government Agency *Marae Moana* into existence in 2017, with a remit of holistic management of the marine affairs of CI EEZ ocean waters with respect to conservation, ecological management, biodiversity protection, and economic development. CI Prime Minister, Henry Puna, delivered a series of talks on the international stage, including the United Nations, over a c. two-year period prior to the creation of *Marae Moana*, concerning the creation of a marine park within the Cook Islands EEZ. In March 2017 CIG passed an agreement that extended a 'no development zone' to 50 nautical miles radius around all islands within the CI EEZ. At the time of writing, it remains uncertain exactly what role *Marae Moana* will play with respect to the management of seabed mining. It is likely however that *Marae Moana* will play an important coordination role over all marine based activities within CI waters, as well as developing whole-ocean-EEZ policy.

From 2009 to 2017 CIG set in motion an unprecedented series of governance administration units, laws, policies, and regulations for seabed minerals: a world 'first' in this area. Taken together, the administrative units and governance tools could form a base for seabed mining management. Governance systems remain to be 'tested in action' by an active industry. CIG and CISMA are currently progressing a range of work including: 1) further development of human resources skills mining (e.g. scientific, legal, fiscal, administration; 2 preparation of the community; and 3) continuously evolving law, regulation and policy.

CISMA attracts a range of criticism and questions regarding its role and raison d'etre. Mostly, arguments focus on the existential situation that government has created an administration for an industry that does not yet exist. Whilst many see this action as visionary, and preparing for a probable future, some argue that the seabed mining industry remains a long way off, and that it is difficult to justify CISMA.

3.2. Seabed mining and environmental considerations

SPC (2013) and McCormack (2016) have provided analyses of seabed mining and environmental issues. This section summarises key areas that require consideration by CIG seabed mining governance. Readers are directed to original references for further reading. Fig. 8 illustrates one conceptual model for nodule mining. The mining process is controlled by a 'fixed' mother ship at the ocean surface that is in communication with remotely operated seabed mining production machines on the ocean floor. The seabed mining production machines will extract nodules through a combination of digging, suction, or scraping processes. A mixture of ore and seawater slurry will be lifted from the ocean floor to the mother ship through riser/pumping systems. Due to high water depths, the lifting of the slurry will most likely require booster pumps to ensure unhindered flow of slurry from the seafloor to the mother-ship. As the slurry is discharged onto the mother-ship it will be dewatered. The ore will be separated from seawater and sediment. The ore will then be transported via ore-barges, whilst the

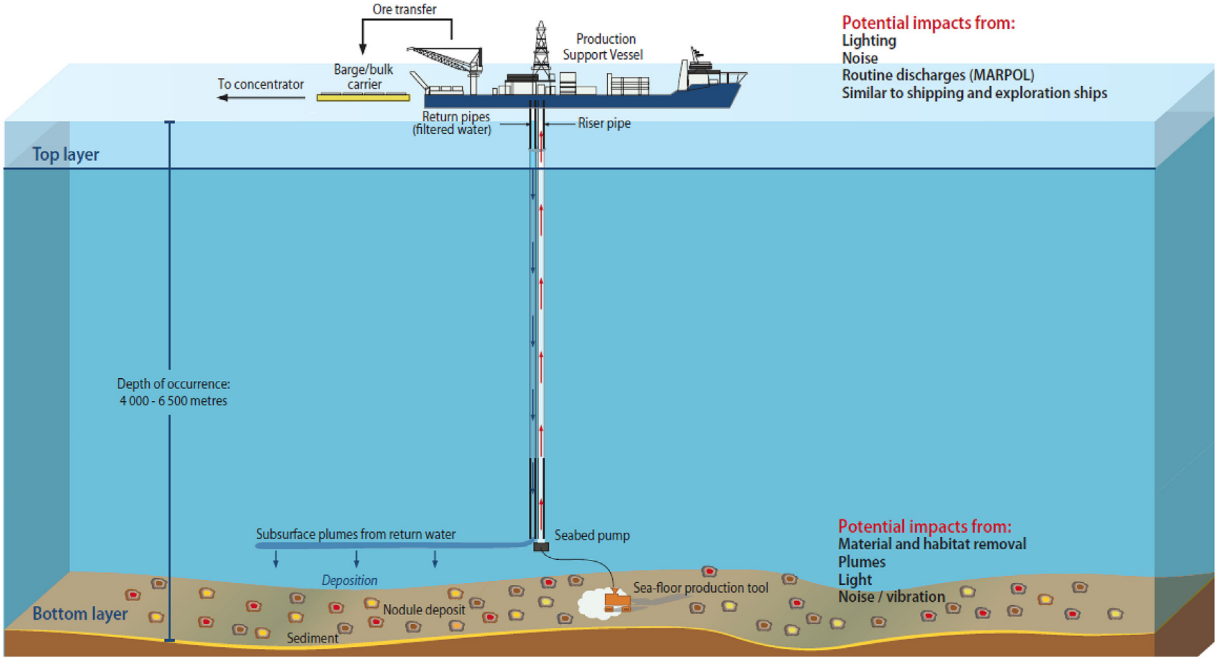

Fig. 8. Schematic cartoon of a manganese nodule mining operation. SPC (2013).

seawater will be returned to the ocean at a pre-determined depth. Ore barges will transport the ore to ports that have facilities for large transportation vessels, where it will be trans-shipped to a refinery.

Whilst mining will have the most significant environmental impacts, exploration and a bankable determination of a seafloor resource, will involve research vessels, remotely operated submarine observation vehicles, sampling of the ocean floor (for geology, mineralisation, substrate, biology), imaging, mapping, and so forth. These activities will provide much of the baseline knowledge for the environmental management of mining.

Mining has the potential to cause a range of adverse environmental impacts (e.g. McCormack, 2016), including noise, light and seabed disturbance (sediment and habitats), life-form destruction, sediment plume formation, ore-slurry leakage, mixing of various seawater-types, pollution, and interaction with other ocean-users (e.g. fishing boats) and large mammals/Cetaceans. Damage to unique biodiversity and ecosystems present on the oceanic abyssal plains is of particular concern (SPC, 2013; McCormack, 2016).

McCormack (2016) has undertaken a detailed review of the potential impacts of MN mining for Cook Island waters, particularly for the Penrhyn Basin. McCormack's analysis is informed, in part, by an analysis of MN operations within the Clarion Clipperton Zone, by Argarwal et al. (2012). The Precautionary Principle is stressed. This gained international recognition as Principle 15 of the Rio Declaration on Environment and Development at the Earth Summit in 1992. The Precautionary Principle states that government cannot use the absence of data to avoid taking environmental protective measures. CISMA Regulations (2015) for seabed mining adopt the Precautionary Principle. One key governance implication is that it becomes the responsibility of the developer to prove that they have generated a range of methods, plans, technologies, and other approaches, to minimise adverse environmental impacts. A failure to do so will result in mining applications being refused. McCormack (2016) examines a range of factors relating to seabed mining and the environment, including the nature of the biodiversity and biology in the Penrhyn basin. Recommendations for best practice include: 1) the production of a statistically valid environmental data set; 2) the creation/management of biodiversity preservation areas outside of the mined area; 3) the development of lowest-impact ocean floor mining systems; 4) the implementation of riser systems that isolate ocean floor seawater and mixed ores from the surrounding ocean column; 5) the return of ocean bottom water to depths of at least 1500 mbsl; and, 6) the development of downwards pointing ocean floor lighting systems to minimise impacts on bioluminescent animals.

McCormack, pers. comm., (2017) advocates, that the provision of exploration/mining licences must only be granted on condition that credible proposals for extensive biological sampling, alongside geological sampling, and mineral reconnaissance, are submitted. Changes to the existing legislation will be required to reinforce, and enforce these suggestions.

3.3. The role of non-government actors and indigenous environmental thinking

Governance of minerals is not only the concern of Governments and companies. There are a range of stakeholders who have legitimate mining interests. It could be argued that for the situation of CI, with a small population, and limited economic options, ALL citizens are stakeholders, as they should have a strong personal interest in the minerals-wealth money flow. They can become guardians of two vital developmental questions: how exactly is mineral generated wealth is being utilised for national good?, And, is any/some of the money flow leading to negative consequences?

A number of CI-NGOs, and the Pacific regional-NGOs have addressed seabed mining from various angles. Alongside official NGO organisations, two societal elements present in Cook Islands (and many Pacific Island countries) play a significant role in governance.

One key social element is represented by the traditional governance system (Fig. 9, Tables 4 and 5). Pacific Island countries are largely-governed by Indigenous peoples, and are influenced by the history, culture and value systems of Indigenous tribes and leaders. Within CI the *House of Ariki* (Paramount Chiefs, heads of c. seventeen tribes) are the highest form of traditional governance with the *Koutu Nui* forming a council of five hundred Chiefs who work to the *House of Ariki*. Some parts of CI, particularly within Outer Islands, are strongly influenced by this traditional leadership structure. Government members may themselves have traditional governance roles or leadership positions, in addition to a formal 'Westminster style' government portfolio. Pacific

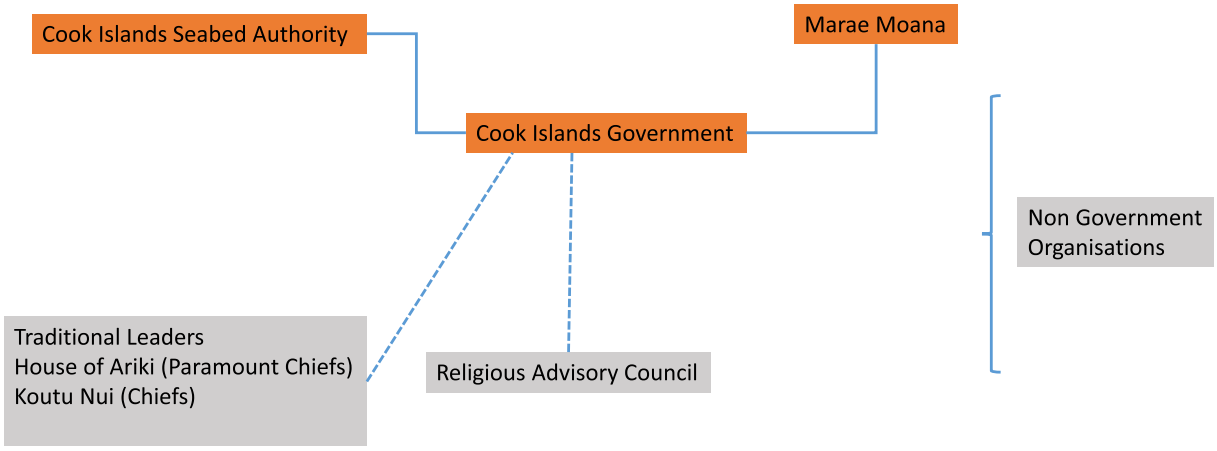

Fig. 9. Key stakeholders involved in the development of governance and regulation for Cook Islands seabed minerals.

people tend to be more communal and community-centred when compared to a more individualistic 'Western society,' and view land-ownership and asset-ownership as within-community custodianship, for community benefit. Values of inclusion and knowledge-sharing are strong. Decisions are often informed through community meetings within *marae* or traditional community meetings between leaders and elders, and community representatives. The environment is viewed in holistic terms. Present generations are therefore environmental custodians, not *environmental owners*. Humans are part of the environment, not separate from the environment. It is paramount, in traditional thinking, to maintain and add value to environmental systems and resources for the benefit of future generations (the inter-generational principle). Island people have a strong affinity with the ocean, as much of their needs and lifestyles are traditionally dependent on the ocean, and its health. These values inform opinions, and community debate on issues such as fishing and mining, which can be contentious. In general, Pacific Indigenous peoples are mindful of environmental-custodianship and connectivity: for example even the deep ocean is connected to the shallow reef seas, that are part of most landowners' tenure-ship. Of course, the 'modern world' with its cash economy, reductionist philosophies, space and information age technology, and so forth, strongly influences traditional Indigenous culture and belief systems. Today's Cook islanders understand modern-day realities as well as valuing the systems and histories from which they came. Traditional governance encourages the formal constitution to meet with it, and be advised by it, within CI. It believes it has a role to play in guiding and advising, and, for some issues, it is particularly influential. The *Marae Moana* government initiative has been developed, in part, to embody Indigenous value systems for holistic ocean governance. Interviews with Cook Islander Traditional Leaders and *Marae Moana* in November 2017 (Table 5) highlighted some key messages relating to seabed mining which included: 1) the position that, although seabed mining will take place in remote and deep locations, there is a connection, through the ocean, with landownership of reefs. Development on-land, and within-reefs, in CI, require extensive landowner negotiation, and community buy-in. It is, therefore, imperative upon CIG to discuss all aspects of seabed mining with the CI Traditional Leaders and people; 2) partnership with mining operators is important. Partnership should aim to equalise any potential power asymmetries between CIG, people and the company. All aspects of mining operations (e.g. technology, intellectual property rights, mining profits) should be undertaken in partnership with CI with a view to equitable benefit sharing. This reflects inclusivity and involvement principles; 3) environmental management is important for ocean health. Companies should only be contracted if they can demonstrate seriousness and technical capability for environmental management; 4) Traditional Leadership has a governance advisory role to play, and models will be examined to ensure that dialogue and advisory fora are created to facilitate the hearing of Traditional Leaders voices at government levels. The setting up of a CISMA Advisory Board is viewed as a positive first step.

A second CI social element is the religious organisations (Fig. 9, Tables 4 and 5), largely Christian churches, who have a strong representational and leadership role for their congregations, and are influential within government circles. Within CI there is a Religious Advisory Council (RAC) who distil and synthesise church and religious thinking with respect to key topics. The RAC view seabed mining in a largely positive manner, so long as certain safeguards are employed, with respect to potential environmental and social impacts. Of strongest concern is the potential for a large windfall of money from mining to skew society in terms of spiritual values and economic activity. RAC view examples of poor practice in other countries where society has been adversely affected, with few lasting tangible national benefits (e.g. Gale, 2016). RAC is strongly supportive of CIG preparing the ground for mining, and the setting up of CISMA. RAC would like to see a number of actions progress, including: 1) the development of appropriate within-country human resources in areas such as law, science, technology, engineering, finance, administration, and so forth; 2) the creation of a Sovereign Wealth fund; 3) taking the principle of inter-generational planning of mining-won wealth seriously, and embodying this principle in policy and action; and 4) being mindful that a future prosperous CI would not only stem the flow of outward migration, but reverse this flow, with the attraction of significant numbers of the Cook Islander diaspora. How can this situation be best modelled and managed?

The most relevant NGO Organisation in CI with respect to seabed mining is the *Te Ipukarea Society* (TIS) who espouse the philosophy that the present generation does not own land and marine resources but borrow them from the next generation and need to return them in good condition (www.tiscookislands.org) (Fig. 9, Tables 4 and 5). TIS is a member of the International Union for Conservation of Nature (IUCN) and Birdlife International. TIS promotes awareness and disseminates information on a range of issues relating to conservation, and sustainable development. They also campaign for environmental issues viewed as particularly important: for example, in 2017, TIS led a public campaign against aspects of commercial fishing within the CI-EEZ. TIS engage with a range of actors from all sides of development, but retain independence. In 2013, TIS, in collaboration with the Pacific Community, and CISMA, held a school public speaking competition on the theme of Deep Sea Minerals, and used this to raise awareness of seabed mining. TIS do not hold a necessarily anti-mining stance, but emphasise that the industry, if it goes ahead at all, should go ahead with caution, adopting the Precautionary Principle. There is a preference for mining to occur in international waters (if it has to happen at all). If decisions are made to mine within the CI EEZ, TIS will lobby for the highest possible environmental and social safeguards to be applied and to

Table 2
A summary of the major developments in governance related to seabed minerals and global contexts for the period 1974 to 2017. Source include a range of academic literature cited in the Reference list, Cook Islands News media releases, and data from CISMA office.

Date	Milestone	Significance	Comments
1974	Soviet Research Vessel *Vityaz* explores and samples Cook Islands Manganese Nodules	Future Deputy Premier & Queens Representative, Tom Marsters, onboard. First samples from Cook Islands waters.	Future senior political figure becomes engaged in the possibilities of nodule harvesting
1982–1994	UNCLOS (Law of the Sea) opened for signature in 1982 and came into force on 16th November 1994.	UNCLOS formalised national ocean boundaries and the Economic Exclusive Zones allowing Cook Islands to define its ocean maritime boundaries	UNCLOS defined rules of engagement for countries and companies within international waters 'The Area'.
1985–2005	Japanese Research Vessels (e.g. the *Hakurai Marau*) in partnership with *SOPAC* undertake the most comprehensive oceanographic surveys of the Pacific. Several oceanographic surveys were undertaken within the Cook Islands EEZ during this period. Numerous other Pacific surveys from USA, French, New Zealand, and other research ships between 1974 and 2005 supplement the Japanese data.	Information from Cook Islands waters informs the generation of new geological and mineral resource maps	New data allows for an informed ore grade assessment and range of grade variations within EEZ. Cook Islands recognised as containing the greatest concentration of nodules in national waters.
1994	The International Seabed Authority held its inaugural meeting on 16th November 1994, Kingston, Jamaica.	Cook Islands became a member alongside 166 other countries and the EU	Creation of ISA allowed more active engagement of Cook Islands within a formalised international context for deep sea minerals
1995	East West Centre in Hawaii makes the most detailed assessment to date of the resource value of Cook Islands seabed nodules.	Some 650,000 km^2 of CI EEZ are estimated to have a nodule density of $> 5\ kg/m^2$. A world-class resource is recognised.	7.5 Billion tonnes of nodules estimated to contain 32.5M tonnes of Co, 24 M tonnes of Ni and 14M tonnes of Cu.
1997	Papua New Guinea issues the first deep seabed minerals exploration licence in the world within national waters	Pacific countries observe that deep sea mining may become a reality	Nautilus progresses towards a full mining licence.
2001–2	Seven, fifteen year-long exploration licences granted by ISA for exploration within the Clarion Clipperton Zone (CCZ), Eastern Pacific	A new phase of high-technology modern exploration of the ocean floor begins	Cook Islands maintains a watching brief of ISA activities and explores possibilities for Cook Islands.
2009	Cook Islands, working with the Commonwealth Secretariat passes the world's first legislation for seabed minerals within national waters.	The law makes a clear commitment statement of Cook Islands Government towards Deep Sea Minerals	Legislation is the first step for developing business. This opens the door for the creation of the Cook Islands Deep Sea Minerals Authority
2011	Papua New Guinea grants Nautilus a Seabed Mining Licence	This is the first licence of its kind in the world	Nautilus progress slowly to mining stage. Latest press statements suggest 2019 for the year mining commences.
2012	26 June: Cook Islands approves the commencement of the Seabed Mineral Act	Cook Islands Government approves the establishment of the Seabed Minerals Authority	Government prepares for a new stage in seabed minerals governance.
2012	Cook Islands Seabed Minerals Authority (CISMA) formally inaugurated, 26th June 2012	CISMA created to refine, regulate, manage and enact the Cook Islands Law for Seabed Minerals, develop policies and regulations, and promote mineral prospectivity.	CISMA is the first governance body of its type in the world.
2012-present	CISMA employs a range of longer and shorter-term technical staff. Data related to Cook Islands seabed minerals and their governance re-evaluated, re-modelled and re-presented/updated. A range of scientific, legal, regulatory and policy documents result from this work. The capacity and experience base of CISMA is deepened and strengthened.	CISMA benefits from being part of the European Union funded SPC (Pacific Community) Deep Sea Minerals Project (SPC, 2012), alongside 14 other Pacific countries. This project assists with technical development for many aspects of seabed minerals.	CISMA actively promote capacity development, especially for Cook Island nationals, by taking advantage of collaborations offered by the EU-SPC project, ISA & Commonwealth Secretariat initiatives, and similar.
2013	March 1st, 2013: Cook islands Seabed Minerals Advisory Board established	Board comprises independent members of the community from a range of stakeholders and geographical regions	The Board is the official vehicle for discussions between government and community for seabed minerals.
2014	Cook Island Seabed Policy Agreed and Published	CISMA evolving laws into policy	Strengthened governance.
2014	August 2014: Cook Islands deposits, for the first time, the full and complete geographic coordinates of its complete EEZ with UNCLOS.	Cook Islands has negotiated maritime boundaries with its neighbouring countries from 1980.	Cook Islands actively pursues a claim for an extension to its EEZ based on the continuity of the Manihiki Plateau.
2015	Cook Islands Prospecting & Exploration Regulations agreed & published	CISMA develops increasingly refined governance, legal and policy tools required for business and environmental protection.	Cook Islands preparing to take advantage of partnering with a major company for exploration in the CCS
2015	New Seabed Minerals Amendment Act passed	CISMA refines legal tools as a deeper understanding of seabed mining grows	Evolving law, regulations and policy give a strong message of Cook Islands readiness & level of seriousness for seabed minerals.
2015	CISMA open national waters for international tender for seabed minerals exploration	Designated areas of the EEZ open for tender	Prospective applicants advised of the Seabed Minerals Act 2009, Seabed Minerals Policy, 2014, Seabed Minerals Amendment Act, 2015, Seabed Minerals (Prospecting and Exploration) Regulations, 2015.
2016	15 July 2016: ISA grant a 15 year exploration licence to the Cook Islands Investment Corporation	Cook Islands partner with G Tech Sea Mineral resources (Belgium) for exploration within the CCZ, East Pacific.	Cook Islands realise strategic goals in seabed minerals beyond Cook Island national waters
2017	Two agreements (May 15 & Oct 31) between Cook Islands Government and Ocean Minerals (Texas, USA) for exclusive exploration rights to 15,000 km^2 of national waters.	No seabed licence granted at this stage. Agreement indicates serious international commercial interest	Commodity markets becoming more optimistic. Increased possibility of exploration interest.
2017	September 17th: Japan announces successful deep sea test mining at depths of 1600 m. Although this		

(*continued on next page*)

Table 2 (*continued*)

Date	Milestone	Significance	Comments
	work is for polymetallic sulphides rather than nodules it messages that deep sea mining is close to realisation.	This news provides further encouragement. Japan announce they will mine by 2020. This brings the advent of deep sea mining closer.	Japan demonstrates new technical capabilities of extracting ore and bringing it to the surface. A world first.

maximise benefits of mineral-won wealth for national good and community benefits.

3.4. PANG (Pacific Network on Globalisation)

More widely, there are some NGOs and Church Representatives within the Pacific Islands region who hold strong, anti-seabed mining views, and campaign against mining. Some have commissioned studies that emphasise 'alternative and informed analysis, challenging neoliberal development' (e.g. www.pang.org.fj). PANG (the Pacific Network on Globalisation) is an NGO that aims to 'provide and alternative voice in defending and promoting Pacific people's right to economic self-determination' (www.pang.org.fj). PANG (2016, 2017) commissioned publications such as: 1) '*Resource Roulette: How Deep Sea Mining and inadequate regulatory frameworks imperil the Pacific and it's peoples',* and; 2) *'An assessment of the Secretariat of the Pacific Community Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation,'* that provide alternative views and arguments, encouraging Pacific Island Nations to be careful and cautious with respect to seabed mining. Issues such as levels of present day ignorance about seabed mining, particularly with respect to biodiversity, ecology, deep-sea environment, and the reality of mining practices, are emphasised. PANG asks if Pacific nations can effectively manage the potential ills of seabed mining, should it become a major revenue earner including corruption, political and economic instability, the skewing of economies (Dutch Disease), community and social impacts, and pollution. A review of Pacific Nations legislation and policy for seabed mining by PANG concluded that the documents were heavily influenced by bodies outside of the Pacific Nations themselves, and that much of the legislation does not include indigenous or human rights provisions. PANG argue that the proposed ways forward have limited environmental protection safeguards, and only cursory mention of the Full, Prior, and Informed Consent Principle (FPIC), the Precautionary Principle, and transboundary potential impacts. PANG continues to press Pacific Island leaders and Pacific Island nations to become more open, inclusive and interrogative of all aspects related to seabed minerals, and to involve their peoples in detailed and extensive awareness raising, as well as genuine informed-opinion gathering. The rights of Indigenous people and the principle of FPIC are paramount and should dictate any progress related to seabed mining.

3.5. Cook Islands marine park and Marae Moana

One method of countries addressing the difficult debate between economic activities such as mining and fishing, and 'active' environmental protection, is to declare and define *marine conservation parks* with associated environmental and planning restrictions (e.g. no-mining zones). CIG has, at various times, made international declarations for the creation of a marine conservation park. The area/extent of the concept has varied over time. From circa 2012, discussions revolved around the idea that half the area of the CI-EEZ (c. one million square kilometres) would become a marine park. In 2017 CIG statements began to encompass the whole of the CI-EEZ in terms of holistic ocean governance. A boundary of fifty nautical miles radius was set around all 15 Cook Islands with no development allowed within this space. *Marae Moana* was set up (Fig. 9, Tables 4 and 5) as a legal government entity in 2015. *Marae Moana* means 'Sacred Ocean' and aims to incorporate Indigenous peoples principles in addition to other developmental models in managing the CI ocean. *Marae Moana* professes a 'whole domain' approach for management, protection, and conservation within the CI-EEZ. All aspects of development that affect the ocean such as tourism, fisheries, maritime transport, aquaculture, law, and mining will be examined within the 'whole ocean' management concept. *Marae Moana* aims to promote awareness of ocean issues amongst Cook Islanders and promote a 'renewed sense of ownership' amongst CI communities. *Marae Moana* will liaise and collaborate with all CI government departments that have an ocean role, including CISMA. The delicate and dynamic balance between conservation/ecosystem protection and economic development will become increasingly important.

4. Critical analysis: towards a sustainable development solution for seabed minerals in the Cook Islands?

This paper has documented a range of activities undertaken by the CIG, supported and advised by a range of external advisors and organisations, as well as reporting a range of values, concerns and opinions of stakeholder groups and communities, (Tables 2–5). The gross trajectory of Cook Islands governance with respect to seabed minerals is a growth curve over a considerable time period. Since independence in 1965 the issue of seabed minerals has been present within government discourses. This has led to periods of raised public awareness for seabed minerals and the gradual shaping of government policy. Tangible developments have occurred, mostly, since the passing of the world's first seabed minerals and mining act in 2009. This was followed by the creation of CISMA in 2012, and the development of a range of policies, act amendments, regulations, and a tendering/cadastre process. CIG's increasing engagement with the international community (e.g. through the International Seabed Authority, the Commonwealth Secretariat, and the Pacific Community), and incorporation of scientific evidence and opinion have all shaped governance evolution.

4.1. Sustainable development, stakeholder views, inclusivity, and regional NGO mining opposition

Sustainable development principles have received some policy expression. One example is the commencement of processes that could lead to the setting up of a Sovereign Wealth Fund and a State Owned Enterprise to partner with a Belgian exploration company in international waters (Tables 2 and 3). The government has created an advisory board for seabed minerals that includes a range of stakeholders and drafted an agreement with the company *Ocean Minerals* to move forwards carefully in regards to exploration within the CI EEZ. The formation of *Marae Moana* and developments with respect to holistic EEZ ocean governance indicate a desire to ensure 'balanced development' that protects the ocean environment (Fig. 9, Tables 4 and 5). The majority of the wider non-governmental stakeholder base including Traditional and Religious Leaders, local communities, and NGO/Environmental groups hold positions that can be described as 'pro-mining for national good', to anti-mining within the CI EEZ (Tables 4 and 5). The most vociferous anti-mining positions are held by organisations with a base outside of CI. PANG, for example, are deeply sceptical of Pacific development based on 'outside' drivers and analyses informed largely by 'Neoliberal economic philosophies'. These types of development have, in PANG's analysis, led to undesirable social and economic consequences for Indigenous people in the past, and will probably do so in the future. PANG, and similar stakeholders, prefer development to

Table 3
Detailed Transactional History of CISMA and related CIG Activities 2012–2017. Sources, Cook Islands News media releases and data from CISMA office.

Date	Activity	Comments
March 2012	Darryl Thorburn appointed as Natural Resources Adviser to Cook Islands Government	This appointment fulfilled a condition of the Seabed Minerals Act (2009). Funded by ComSec.
May 2012	Government advertises for up to 15 training opportunities for a range of disciplines related to Seabed Minerals and Mining.	Funded by International Seabed Authority
June 2012	Sovereign Wealth Fund proposed in Parliament	Start of long term fiscal policy
August 2012	CI Government Delegation attends an international mineral resources meeting in Jiangxi China	CI beginning to embark on its international awareness raising for seabed minerals. Acknowledgement of the leading role of China in seabed resources.
August 2012	NGO anti-seabed mining campaign presents arguments against mining to the Pacific Islands Forum Meeting in Rarotonga	PANG (Pacific Network on Globalisation) vocalise a persistent anti-mining campaign influencing NGOs and some church leaders.
September 2012	Paul Lynch appointed as Seabed Minerals Commissioner	Commissioner heads the new Seabed minerals Authority Crown Agency with an initial annual budget of $300 K NZ.
October 2012	CISMA attends 41st Underwater Mining Institute meeting in China	First Cook islands attendance at this international forum.
November 2012	PNG anti-seabed mining campaign	24,000 signatories against seabed mining in New Ireland waters
November 2012	CISMA's first general public update meeting	Ten community representatives attend
November 2012	Alex Herman, Cook Island national, begins work as a legal advisor	Initially the appointment is a secondment to SOPAC in Fiji. CISMA strengthening its capability
December 2012	Marino Wichman, Cook island national employed as a GIS and geospatial officer for CISMA	CISMA strengthens its capability.
February 2013	CI Government Foreign Affairs send delegation to the United Nations in New York	Negotiations for an extension to CI EEZ. This can add 410,000 km^2 to EEZ. Continuation of process that began in 2009
March 2013	Nine community representatives appointed to seabed minerals authority advisory board	Official recognition of social and community interaction
March 2013	Professor David Cronan announces results of a 6 month study into the geology and chemistry of CI Nodules	Cronan concludes that CI nodules are richer in Co, Ni, Cu, Ti, Mn,Y and REE than previously thought
June 2013	CI Government presents its seabed minerals experience to the European Parliament in Brussels: to the African-Caribbean-Pacific/EU Joint Parliamentary Assemblage.	This is a world first and indicates the commitment of CIG to work within the global platform for seabed minerals
June 2013	Canadian Company Endeavour make a $25M NZ offer for exploration licence rights to CIG	Commercial interest demonstrated in CI waters
August 2013	Public Consultation on the subject of a possible Sovereign Wealth Fund	Sovereign wealth Fund is viewed as perhaps the best option for long term fiscal management of seabed minerals revenues
September–October 2013	Te Ipukarea, a CI Environmental NGO launch a youth debating competition on seabed minerals	Further development of community interactions
December 2013–January 2014	CIG applies with Belgian company G-Tec Sea Mineral Resources for exploration rights in the Clarion Clipperton Zone	CIG explores opportunities in international waters. License approval was granted July 2015 for three areas totalling 75,000km2.
May 2014	Financial aspects of seabed mining conference held in Rarotonga	SPC project held a series of seabed mining workshops across the Pacific region on key themes
August 2015	First international tender for seabed mining in CI waters released	CI declares to the world that it is open for business
February 2016	CISMA announce that it has not received any bids to explore for seabed minerals	Disappointing setback for CISMA. Expressions of interest received from Korea, Japan, UK, US, China and Germany
February 2016	Cost Benefit Analysis of three Pacific case studies for seabed mining, commissioned by SPC & undertaken by Cardno SPC released.	Assessments are positive for Cook Islands and PNG but less so for Marshall Islands
May 2016	CI Chamber of Commerce release a report critical of Government for the growth of Government and Government Authorities/Agencies. 52 Agencies identified: one for every 250 CI Inhabitants.	CISMA identified as one agency that could be rationalised until mining commences. Government employs 40% of the work force of CI.
July 2016	Minister Mark Brown signs Joint Venture agreements between CIG and Belgian Seabed Mining Company GSR at UN HQ in New York	CIG closer than ever before to seabed mineral exploration and mining.
September 2016	Cook Islands Investment Corporation enter into an agreement with Ocean Minerals (US seabed minerals company) concerning the granting of contractual rights to prospect and explore for seabed minerals within the CI EEZ. Ocean Minerals themselves will collaborate with US Company Deep Reach Technology Inc. Ocean Minerals cite CI's existing laws and regulations and stable governance factors in deciding to invest in CI.	Approximately 12000km2 to be reserved whilst giving Ocean Minerals options to other areas. Ocean Minerals to pay a monthly fee beyond statutory licence fees, and fund training. Interests could include sediments as well as nodules.
September 2016	CI Natural Trust release an information booklet on seabed mining & the environment	Independent review of potential environmental challenges in CI waters
March 2017	CIG agree to a 50 nautical mile exclusion zone around islands	The concept of a CI Marine Park, having been discussed for several years now maturing
May 2017	Cook Islander joins Belgian company GSR cruise in the CCZ	International activity begins for CI Seabed Minerals
June 2017	Prime Minister Henry Puna announces future CI Marine Park at United Nations in New York	CIG developing governance and ideas for a marine park and holistic marine management
July 2017	Marae Moana formed as a government body with an associated Marae Moana Government act.	CIG forms a new agency to protect and conserve the biodiversity of the CI EEZ Marine Park
October 2017	CIG signed a second agreement with Ocean Minerals to give first rights for exploration over designated waters in the EEZ	Deal worth $100 K to reserve 23,000km2 demonstrating income earning potential

occur that is in sympathy with indigenous values, springs from indigenous values, and is 'bottom-up' in terms of its inception and progression. Development that is 'outside-expert-driven,' fuelled largely by the profit-motive, is the least welcome style of economic change.

Table 4 (informed in part by interviews with personnel listed in Table 5) summarises a set of five stakeholder positions with respect to motivation, values, desired outcome and mitigating circumstances. This matrix captures a range of positions, values and thinking from the most important stakeholder groups, with respect to seabed mining in CI. At one end of the spectrum is the, as-yet undefined, external company (or country organisation) attracted to mining in CI. Profit will be significant and a key driver, particularly for Western-style private sector

Table 4
Cook Islands Stakeholder Motivation and Values Matrix for Seabed Mining. Data from interviews noted in Table 5, and a wide range of activities within the SPC-EU-Deep Sea Minerals Project, 2012–2017.

Stakeholder	Motivation	Values	Desired Outcome	Mitigations/Concerns
Company	Profit, new frontiers, new technologies, enhanced reputation	Business driven values with profit/loss, opportunity and reputation paramount.	Successful mining operation delivering strong profits and enhanced company reputation	Company confidence increased by good government, high commodity prices, and growing markets
Government	Development of a sustainable and lucrative addition to the GDP. Diversifying an economy with limited options for growth. Aiming to be economically self-sustaining.	Must balance the requirement for a balanced national budget, with environmental and social impacts.	A well administered, profitable, long-lasting industry with positive development & social outcomes	Company poor practice. Environmental deterioration. Social unease/unrest. Development of new adverse social problems. Increased inequality. Power asymmetries to be managed (e.g. large company-small state)
Traditional Leaders	New opportunities for indigenous people, an equitable division of benefits, and protected environment	Inter-generational assets protected/enhanced. Holistic environmental and social management. Social cohesion & stability. Inclusion in decision-making processes.	A new industry presenting a range of employment and life-enhancing opportunities for indigenous people. Successful environmental & social outcomes	Being ignored. Inability to influence. Social unrest caused by corruption, inequality and inequitable benefit sharing. Potential to despoil the environment.
Religious Leaders	Improved national & societal affluence providing this is well-managed. Returning Cook Islander diaspora. Environmental protection.	Spiritual welfare of Cook Islanders. In material terms this includes a healthy wellbeing, equity of benefits and opportunities, and a healthy environment.	Shared wealth and prosperity leading to improved national wellbeing	Inequality. Corruption. A skewed economy overly dependent on welfare for some and 'Dutch Disease' impacts for others. Increase in social problems
NGOs	A spectrum of motivation. One group can live with well-managed mining. Another group will do what it can to stop mining.	All value a healthy environment & society. One group is highly sceptical of 'Neoliberal' development and consequent negative impacts. A holistic, in-region, form of development advocated.	One group can accommodate a well- planned and well-managed mining operation providing there are demonstrable benefits. A second group will view mining development as highly undesirable.	One group: good company reputation, best mining practice, good governance, transparency, open decision making & open money flows. A second group could possibly accommodate a wholly-within-region cooperatively- owned small scale operation.

Table 5
Names and affiliations of technical interviews between Petterson and key stakeholders, November 2017.

Name	Affiliation/Position
Mr Paul Lynch	Commissioner, Cook Islands Seabed Minerals Authority
Mr Garth Henderson	Finance Secretary, Cook Islands Treasury Office
Mr Kevin Iro	Marae Moana
Mr Josh Mitchell	Foreign Affairs Secretary, Cook Islands Department of Foreign Affairs
Mr Kelvin Passfield Mr Ian Karika Ms Alana Smith	Te Ipukarea Society (Environmental NGO)
Gerald McCormack	Director, Cook Islands Natural Heritage
Ms Teresa Trott	CISMA Advisory Board
Mr Rashneel Kumar	Journalist, Cook Islands News
Pastor Bobby Matapo Bishop Tutai Pere	Cook Islands Religious Advisory Council
Paul Allsworth	President of Koutu Nui, Traditional Leaders Council
Mr Tom Marsters	Queens Representative, Former Deputy prime Minister, Cook Islands
Minister Mark Brown	Minister of Financial and Economic Management, Minister in charge of CISMA

companies. However, as this is a frontier area, with potential benefits not only for commodities, but also for testing of new technologies, robotics and communications systems, some organisations, particularly state-supported/sponsored companies from China, Korea or Japan (as examples) may view 'profit' as a longer-term and wider-based concept than merely short-term return on investment. Companies/Countries that develop a large stake in a new ocean seabed minerals industry could be well-positioned to take advantage of new-technology markets, as well as being in a strong geopolitical position for global commodity supply. Companies who become serious ocean mining operations will have a large investment threshold to cross in terms of set-up costs. Ocean mining mother ships, remotely operated robotic seafloor mining equipment, riser systems, and related mining hardware and software, will require large up-front capital costs. Early adopters of seabed mining are likely to see company reputation as critical to success and take environmental management and social impacts seriously. Attractors to investment in CI-EEZ by the international mining community will include factors such as good and stable government, a mature, consistent, and transparent regulatory and fiscal regime, high quality pre-feasibility mineral data on which to base decisions, and a social licence to operate. One advantage that seabed mining has over terrestrial mining is a relative lack of fixed assets to be written-off, should market conditions deteriorate. Ships and robots can be retrieved, and transported elsewhere. Government is key to the future success or failure of any seabed mining operations. The CIG remains in a pre-mining preparation and theoretical stage, although relationships with potential exploration companies have begun. Whether or not any system is fit for purpose requires 'live' testing and this will only occur once mining starts. The win for CI is the development of a new and sustainable, long-lasting industry, that yields a significant new addition to the GDP for decades. Lessons learned from other mining regimes suggest that the most unfavourable outcomes occur with sudden, large-scale mining development that skews the pre-mining economy/society, generates corruption, inequality and poor environmental practice, and occurs within an umbrella of weak governance and regulation (Petterson, 2008). These lessons can inform governance. Mining regimes that maximise national benefit over the long term, are controlled by strong transparent government and regulation, have long-term fiscal management goals, and a community-inclusion approach are likely to be the most successful.

4.2. *Traditional indigenous & religious leader concerns*

Traditional and Religious Leaders hold a special place within Cook

Island indigenous society. Both stakeholder groups are influential within their communities. Their positions on seabed mining are critical to the granting of a social licence to operate. At the time of writing, there is little evidence that these groups are against CIG initiatives to prepare for seabed mining. Both groups worry about population loss from CI to New Zealand, and elsewhere, and see an improved CI economy with enhanced employment opportunities for residents, as key to keeping people within CI and attracting the international CI diaspora. Religious and Traditional leaders look to the longer, rather than the shorter term. Inter-generational management of assets is a value held in high esteem. Safeguards against 'new money streams' skewing the economy in a 'Dutch Disease' style, or too-easily won wealth, (that may cause social problems) are viewed as an essential part of sustainable development for CI. Similarly, safeguards against corruption at the government level, utilisation of money for national good, and environmental protection, are also viewed as critical sustainable development elements. The least favourable group of stakeholders with respect to seabed mining are the environmental, conservation, and Indigenous people-focused NGOs. However, even amongst these groups, within-CI debates and reservations, about seabed mining, are measured. Some groups would prefer that CI concentrates only on mining within international waters. If mining comes to the CI-EEZ it should only happen following extensive community dialogue and scrutiny. Some NGOs external to CI are strongly anti-seabed mining. A particular concern is a perceived lack of due process for Free Prior and Informed Consent, which they argue is minimised or merely patronised, and rarely taken seriously. There are strong concerns regarding highly asymmetrical power relationships between a micro-state and a powerful international/multinational entity, and the impact on indigenous peoples. Stakeholders are aware of examples of large, powerful, countries/companies taking advantage of power asymmetries for their benefit with limited or no benefits for local people. How can CIG ensure a more equitable rebalancing of power asymmetrical relationships?

4.3. Questions to test CIG seabed mining governance

A summary of concerns of Non-Government stakeholder groups in particular (Table 4) is set out as the following concluding questions of seabed mining governance. 1) Has government developed the optimal regulation and policy regime based on international best practice? 2) Can government equip itself, and the wider community, with the human resource skills required to manage a new highly-technical industry and power-asymmetry dynamics? 3) Can the benefit and money stream be clearly visible, open and transparent? 4) Will the mechanisms for stakeholder interactions (between company, government, religious and traditional leaders, and other community representatives) as well as NGOs, be sufficiently inclusive and empowered? 5) How robust are systems for monitoring and evaluation of company activities and accompanying penalising regulations? 6) How will social impacts be monitored/managed? What interventions may be required?

CI is at a challenging juncture with respect to seabed mining. The government has invested quite heavily for an industry yet to arrive. The Government is exposed to criticism that it is unnecessarily expending money for an administrative unit that is (arguably) not even needed. Some stakeholders (Tables 4 and 5) argue that a unit such as CISMA is required to prepare the necessary legal frameworks, promote CI seabed minerals potential and interest, and have a reasonable chance at attracting quality companies within a global market place. *Marae Moana* is a new player in this space, with interesting dynamics to be developed between a holistic conservation and environmental ocean management unit, and other government departments with differing interests. Public expectations may be difficult to manage. On the one hand, part of sustainable development good practice requires free and open dialogue and discussion. On the other hand, the same discussions can raise unrealistic expectations (e.g. for short-term wealth accrual). Seabed mining remains an industry to come. There have been numerous predictions as to when it will actually begin. In September 2017 Japan announced that it had successfully mined sulphide minerals at a depth of 1600 mbsl, close to Okinawa, with a commitment to move to commercial mining in 2020 (Japan Times, 2017). Nautilus Minerals claims that mining will begin within the EEZ of Papua New Guinea in 2019 (Nautilus, 2017). China has strengthened capacity for seabed mining (Tsering, 2017). In 2017 CISMA signed two agreements with the Texan-USA company *Ocean Minerals* for exclusive rights to c. 12,000 km^2 of CI EEZ for exploration and prospecting as well as options for other areas. At the time of writing, *Ocean Minerals* has not progressed to the application stage for an exploration license. CIG remains determined, at least for the medium term future, to maintain governance within the seabed minerals area.

5. Conclusions

Cook Islands Government has embarked on a long journey and relatively detailed process, in terms of time and government resources, with respect to developing national legislation and related tools for the management of seabed mining. This is remarkable considering the small population and GDP of the Cook Islands. CIG has been encouraged to develop some of the world's more detailed seabed mining policies and regulations because of its situational economic realities, and the wealth potential of seabed mining. Like many SIDS, CI has limited options for economic development. Tourism is present to a mature level, but can be a fickle industry. Fisheries have some potential for growth. The arrival of a high-speed internet connection may be a catalyst for new forms of industry. CI has a small land surface area within a remote oceanic location, where transaction costs are high for many industries. There are economic challenges relating to geographic isolation, and small, highly-distributed populations. CI's ability to retain a viable population, attract new residents and investors, and control an overall outward migration trend, must depend, in part, on economic health. From the 1970s, CIG has taken a serious interest in developing the rich Manganese Nodule mineral beds that lie within its EEZ. The knowledge base for the seabed minerals, their mining potential and economic value, as well as ocean floor geology, biology and topography is reasonably good. Current thinking suggest that there is at least 100 years of mining potential present within *just* the richest mineral beds of the CI EEZ. CIG has responded to the increasing technical knowledge base by setting up a Government Seabed Minerals Authority (CISMA), developing a range of seabed minerals legislation and management tools, becoming active internationally, preparing the CI population for a potential mining future, and thinking more widely in terms of sustainable development. A new holistic ocean management body (*Marae Moana*) has been set up with a view to 'oversee' all aspects of ocean management within the c. 2 million km2 of Cook Islands EEZ ocean. This will include an official stake in seabed minerals management. Interviews undertaken for this paper with representatives from government, industry, NGO's, religious leaders, and traditional leaders, provide data on how seabed minerals are viewed from angles that include motivation, values, desired outcomes, and mitigations for identified concerns. The majority of stakeholders are positive about seabed mining, so long as concerns are managed, and government processes are transparent *and* inclusive. The voice of the traditional indigenous culture is considered vital to any future relating to CI natural resource development. There are opposing voices to seabed mining, particularly from external international and regional NGO's. This paper has identified *power asymmetry* between CIG and large multinational mining companies, or large countries supporting seabed mining development, as a threat that will require careful management. The real test of CIG's seabed minerals governance will occur if, and when, mining actually takes place. In the mean-time this paper documents the findings of research into how and why a small island state has become so active and progressive in activities that prepare the ground for a potentially lucrative future seabed mining industry.

Acknowledgements

The authors are indebted to Paul Lynch, Caroline Tiria, Darryl Thorburn, Tom Marsters, Mark Brown, Gerald McCormack, Kevin Iro, Garth Henderson, Josh Mitchell, Teresa Trott, Kelvin Passfield, Alana Smith, Ian Karika, Rashneel Kumar, Bobby Patapo, Tutai Pere, and three referees for their contributions to this article. The authors acknowledge the European Union for funding the SPC-EU-DSM project. MGP acknowledges AUT Research Funds for the funding of the 2017 field mission to Cook Islands. Gerald McCormack is thanked for his generous agreement in the reproduction of some of his figures in this paper. Paul Lynch and Caroline Tiria are thanked for their helpfulness and kindness during the 2017 field-mission to Rarotonga.

References

Argawal, B., Hu, P., Placidi, M., Santo, H., Zhou, J.J., 2012. Feasibility Study on Manganese Nodules Recovery in the Clarion-Clipperton Zone. The LRET Collegium 2012 Series, vol. 2 University of Southampton.

Asian Development Bank, 2017. Transcending the Middle-income Challenge. Asian Development Outlook 2017. 978-92-9257-788-9pp. 341 Mandaluyong city, Phillipines.

Beaulieu, S.E., 2010. InterRidge Global Database of Active Submarine Hydrothermal Vent Fields: Prepared for InterRidge, Version 2.0. World Wide Web Electronic Publication.

Bertram, 2016. Implications of the Cook Islands' Graduation from Development Assistance Committee (DAC) Eligibility Book. http://www.mfem.gov.ck/images/documents/DCD_Docs/Development-Resources/Implications_of_the_CKI_Graduation_from_DAC_Eligibility.pdf.

CIA World Fact Book Cook Islands. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/print_cw.html, Accessed date: 3 November 2017.

Cook Islands Government, 2011. Census of Population and Dwellings. Main Report. Statistics Office, Ministry of Finance and Economic Management. Published by Government of Cook Islands, Rarotonga, pp. 187.

Cook Islands Government Statistical Website. Available at: http://www.mfem.gov.ck/statistics/economic-statistics/national-accounts (Accessed 27.November.2017).

Cronan, D.A., 2013. The Distribution, Abundance, Composition and Resource Potential of the Manganese Nodules in the Cook Islands Exclusive Economic Zone. Cook Islands Seabed Minerals Authority. Report 1, May 2013, Rarotonga, Cook Islands.

Cronan, D.S., Hodkinson, R.A., Miller, S., 1991. Manganese nodules in the EEZ's of island countries in the southwestern equatorial Pacific. Mar. Geol. 98, 425–435.

Elks, F., 2017. Top 50 Mining Companies. Available at: http://www.mining.com/top-50-biggest-mining-companies, Accessed date: 3 November 2017.

Financial Times, 2018. Apple Wins Race to Be First Trillion Dollar Company. https://www.ft.com/content/aebad290-9644-11e8-b67b-b8205561c3fe, Accessed date: 3 July 2018.

FTSE, 2017. All-Share Index Ranking. Available at:. http://www.stockchallenge.co.uk/ftse.php, Accessed date: 7 November 2017.

Gale, S., 2016. The mined out phosphate lands of Nauru, equatorial western Pacific. Aust. J. Earth Sci. 63 (3), 333–347.

Guillaumont, 2010. Assessing the economic vulnerability of small island developing states and least developed countries. J. Dev. Stud. 46 (5), 828–854.

Hannington, M.D., de Ronde, C., Peterson, S., 2005. Sea-floor tectonics and submarine hydrothermal systems. In: Econ. Geol. 100th Anniversary, pp. 11–141.

Hannington, M.D., Jamieson, J., Monecke, Y., Peterson, S., 2010. Modern sea floor massive sulphides and base metal resources: toward an estimate of global sea-floor massive sulphide potential. Soc. Econ. Geol. Sp. Pub. 15, 317–338.

Hannington, M.D., Jamieson, J., Monecke, Y., Peterson, S., Beaulieu, S., 2011. The abundance of seafloor massive sulphide deposits. Geology 39, 115–1158.

Hein, J.R., Koschinsky, A., 2014. Deep-ocean ferromanganese crusts and nodules. In: Scott, S. (Ed.), Treatise on Geochemistry, v.130m, Chapter 11.

Hein, J.R., Mizell, K., Koschinsky, A., Conrad, T.A., 2013. Deep-ocean mineral deposits as a source of critical metals for hi- and green-technology applications: comparison with land-based models. Ore Geol. Rev. 51, 1–14.

Hein, J.R., Spinardi, F.S., Okamoto, N., Mizell, K., Thorburn, D., Tawake, A., 2015. Critical metals in manganese nodules from the Cook Islands EEZ, abundances and distributions. Ore Geol. Rev. 68, 97–116.

IMF World Economic Outlook. 2017. Available at: http://www.img.org/external/pubs (Accessed 10.111.17).

Japan Times, 2017. Japan Successfully Undertakes Large-scale Deep-sea Mineral Extraction. Available at:. https://www.japantimes.co.jp/news/2017/09/26/national/japan-successfully-undertakes-large-scale-deep-sea-mineral-extraction/#.WjM9dPmWaUk, Accessed date: 15 December 2017.

McCormack, G., 2016. Cook Islands seabed minerals. A precautionary approach to mining. Cook Islands Natural Heritage Trust, Rarotonga, Cook Islands, 978-982-98133-1-2pp. 33.

McGillvray, Naude, W., Santos-Paulino, A.U., 2010. Vulnerability, trade, financial flows and state failure in small island developing states. J. Dev. Stud. 46 (No. 5), 815–827.

Nautilus Minerals, 2017. Nautilus Completes US$2M Private Placement. Press Release No 2017-16. Available at:. https://www.japantimes.co.jp/news/2017/09/26/national/japan-successfully-undertakes-large-scale-deep-sea-mineral-extraction/#.WjM9dPmWaUk, Accessed date: 15 December 2017.

Pacific Network on Globalisation. 2017. Available at: http://www.pang.org.fj (Accessed 15.December.2017).

PANG, 2016. Resource Roulette: How Deep Sea Mining and Inadequate Regulatory Frameworks Imperil the Pacific and its People. Report by Blue Ocean Law and the Pacific Network on Globalisation, vol. 91978-982-9083-04-3.

Petterson, M.G., 2008. Minerals sustainability, emerging economies, the developing world, and the truth behind the rhetoric. Est. J. Earth Sci. 57 (2), 57–74.

Petterson, M.G., Tawake, A., 2016. Toward inclusive development of the Pacific region using geoscience. In: In: Wessel, G.R., Greenberg, J.K. (Eds.), Geoscience for the Public Good and Global Development: toward a Sustainable Future, vol. 520. Geol. Soc. Am. Sp. Paper, pp. 459–478.

Phillips, N., 2017. Power and inequality in the global political economy. Int. Aff. 93 (2), 429–444. https://doi.org/10.1093/ia/iix019. 2017.

Pietsch, R., Uenzelmann-Neben, 2015. The Manihiki Plateau- a multistage volcanic emplacement history. Geochem. Geophys. Geosys. 18 (Issue 8), 2480–2498.

Pigrau, A., 2013. The environmental and social impact of Shell's operations in Nigeria. Generalitat de Catalunya. Issue 18, November 2013. Available at:. http://www.icip-perlapau.cat/e-review/issue-18-november-2013/environmental-and-social-impact-shell-s-operations-nigeria.htm, Accessed date: 15 December 2017.

SPC, 2012. Pacific-ACP States Regional Legislative and Regulatory Framework for Deep Sea Minerals Exploration and Exploitation. Prepared by Lily, H, 978-982-00-0557-0pp. 70.

SPC, 2013. In: In: Baker, E., Beaudoin, Y. (Eds.), Deep Sea Minerals: Manganese Nodules. A Physical, Biological, Environmental and Technical Review, vol. 1B. 978-82-7701-120-2, pp. 51.

SPC, 2013a. Deep Sea Minerals: Cobalt-rich Ferromanganese Crusts, a Physical, Biological, Environmental, and Technical Review. In: In: Baker, E., Beaudoin, Y. (Eds.), vol. 1C Secretariat of the Pacific Community.

SPC, 2014. Cook Islands deep sea minerals potential. In: SPC-EU-Deep Sea Minerals Project. Information Brochure Number 11, . http://dsm.gsd.spc.int/public/files/brochures/11_CK.pdf.

SPC, 2016. An Assessment of the Costs and Benefits of Mining Deep-sea Minerals in the Pacific Island Region: Deep-sea Mining Cost-benefit Analysis/Pacific Community. An Assessment by Cardno. SPC Technical Report No SPC00035. 978-982-00-0955-4.

Te Ipukarea Society. 2017. Available at: http://www.tiscookislands.org (Accessed 10. December.2017).

Tsering, D., 2017. China deep-sea exploration: intention and concerns, maritime affairs. J. Nat. Maritime Foundation of India 13:1, 91–98. https://doi.org/10.1080/09733159.2017.1326570.

UNDATA, 2017. Country Profiles. Cook Islands. Available at:. http://data.un.org/CountryProfile.aspx?crName=Cook%20Islands, Accessed date: 29 November 2017.

World Bank. 2015. Available at: https://www.gfdrr.org/sites/default/files/publication/infographic-cyclone-pam.pdf (Accessed 15.December.2017).

World Bank dataworldbankorg (GDP 2016 data). Retrieved December 2017. Available at:: http://databank.worldbank.org/data/home.aspx (Accessed 13.December.2017).

Yesson, C., Clark, M.R., Taylor, M., Rogers, A.D., 2011. The global distribution of seamounts based on 30-second bathymetry data. Deep Sea Res. Part I: Ocean. Res. Papers 58 (4), 442–453.