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► **To cite this version:**

Pierre-Yves Le Meur, Nicholas Arndt, Patrice Christmann, Vincent Geronimi. Deep-sea mining prospects in French Polynesia: Governance and the politics of time. *Marine Policy*, 2018, 95, pp.380-387. 10.1016/j.marpol.2016.07.020 . hal-02510284

HAL Id: hal-02510284

<https://hal.science/hal-02510284>

Submitted on 9 May 2023

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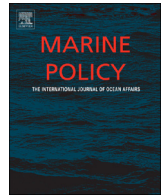
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ELSEVIER

Contents lists available at ScienceDirect

Marine Policy

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

Deep-sea mining prospects in French Polynesia: Governance and the politics of time [☆]



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ARTICLE INFO

Article history:

Received 21 July 2016

Received in revised form

27 July 2016

Accepted 27 July 2016

Available online 3 September 2016

Keywords:

French Polynesia

Deep sea minerals

Seabed mining

Pacific Islands region

Inclusive governance

Timescape

ABSTRACT

This contribution aims at sharing the results of an interdisciplinary expert group review led by the Institute for Development Research and commissioned by the French Polynesian and French governments with the view of reviewing the current state of knowledge on DSM deposits in French Polynesia in order to evaluate the potential for establishing a DSM mining sector, and to make recommendations that could be used as guidelines for developing a policy framework if the exploration and exploitation of DSM resources were to go ahead. The paper focuses on the governance issue in a context of non-independent overseas territory and specifically of the French nuclear testing legacy. The distribution of legal competences between the French and French Polynesian governments is of course at stake but governance is also about inclusion, transparency; it is a matter of redressing asymmetries of information and power and alleviating moral and normative uncertainties. The time dimension of governance – the gaps between the various temporalities and timescapes underlying the DSM activities – will be particularly stressed.

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1. Introduction

International interest in deep sea mineral (DSM) resources began in the 1970s and came to the fore in 2002 as a result of the tensions caused by rising commodity prices linked to the Chinese economic boom. Today's depressed metal prices, a consequence of the weakening of the Chinese economy, is seen as temporary and could be quickly replaced by a new increase in commodity prices albeit at a slower pace than what resulted from the 2003 to 2013 boom of the Chinese economy. This time the raise of prices will come from progressively growing supply/ demand gaps, due to insufficient investment in mineral exploration [1]. Deep sea mineral mining (DSM mining) has not yet occurred anywhere in the world: the most advanced project is the Solwara 1 seafloor massive sulfide project in the Bismarck Sea in Papua New Guinea's exclusive economic zone (EEZ), which is expected to start in 2018 [2]. Many uncertainties remain on the best way to regulate and manage such industry, as documented by the SPC-EU Deep Sea

Minerals Project, a partnership between the Pacific Community (SPC) and the European Union (EU) [3]. Although French Polynesia is not part of this initiative, many common concerns can be noted.

This contribution aims at sharing the results of an expert group review led by the French Institute for Development Research and commissioned by the French Polynesian and French governments with the view of reviewing the current state of knowledge on DSM deposits in French Polynesia. This work evaluates the potential for establishing a DSM mining sector, and makes recommendations that could be used as guidelines for developing a policy framework if the exploration and exploitation of DSM resources were to go ahead [53]. This timeline means that the situation is optimal for the French Polynesian government to put in place regulations for future DSM mining activities within its maritime jurisdiction well before any positive or negative social or environmental consequences occur. The situation provides Polynesian authorities with an opportunity to engage in anticipatory "politics of time" [4] that are tuned to future prospects and uncertainties as opposed to "traditional scientific knowledge and environmental safety regulations [which] tend always to be past oriented" [5]. A proactive approach is crucial for successful natural resources development, and can be phrased in terms of the precautionary principle [6]. Effective governance requires anticipation of both positive and negative developments and prudent regulation of the multifaceted

[☆]The opinions contained in this article are expressed by the authors in their personal capacities and do not reflect the views of the institutions they are associated.

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impacts of future DSM mining. It is commonly agreed that DSM activities can have long lasting, even irreversible, impacts that should be addressed in the intergenerational framework of sustainability, either weak or strong [7]. This issue has far-reaching implications for the governance of DSM, and extends far beyond a purely economic dimension. Particularly for French Polynesia, it includes knowledge creation and diffusion, as well as rent distribution and the participation of all stakeholders.

The focus on the ocean spaces and the sea floor, both in the international seabed area ('the Area') and in EEZs has led to a "scramble for the seas" and its resources [8]. This world-wide process and the inherent risks from "ocean grabbing", or "dispossession or appropriation of use, control or access to ocean space or resources from prior resource users, rights holders or inhabitants" according to Bennett et al. [9: 62], have intensified over the past twenty years. It has been noted that such movement has several and sometimes severe impacts especially on the "sea of islands" [10] and "the people of the sea" [11] that make up the South Pacific. The scramble for the marine spaces and resources is driven by a vision of vast stretches of unappropriated, untamed ocean, nurturing an ideology of *mare nullius* [12]. It echoes the notion of *terra nullius* that justified the colonial conquests in the past century. In this respect, the seafloor appears as a last territorial frontier [13], the conquest of which involves a diverse set of strategies and objectives. The multiple underlying discourses emphasise environmental protection in parallel with, or in opposition to, the obvious economic (mineral resources, fishing zones and quotas, etc.), cultural, political and sovereignty issues. The risk of ocean grabbing (for environmental or mining purposes) is obvious. However, not all processes involving re-allocation of marine space or ocean resources should be qualified as ocean grabbing [9], and prudent marine spatial planning can counterbalance the latter tendency. This is the sense of a recent declaration by the French Polynesian government that rejected a project to create a large-scale marine protected area in the Tuha'a Pae or Austral Islands [15]. Instead the declaration advocated a spatial planning policy in the form of a "marine managed area" encompassing the entire French Polynesian EEZ [16]. This issue recalls the embedding of development and environmental issues in Polynesian party politics.

Governance thus lies at the core of potential DSM mining in French Polynesia. The very limited currently available data point to a very high potential cobalt-rich polymetallic crusts which are known to exist in the French Polynesian EEZ [17]. The critical question is how can the government foster the positive impacts, and control the negative impacts of any future DSM exploration, and any subsequent exploitation on the economies and institutions of the small archipelagos and scattered populations constituting French Polynesia. The answer is very uncertain at this stage, given the many technical, economic, social and political unknowns.

This paper will at first provide an overview of the current context of French Polynesia before to present the existing legal framework, taking into consideration the distribution of legal jurisdictions between French Polynesia and France. The interplay of different legal layers, including international regulations and 'soft' laws, will be discussed in the context of a non-independent overseas territory. In a third section, the paper will give a broad and multifaceted definition of the resources that are potentially available before tackling the political issue of framing a transparent, democratic, socially and environmentally responsible governance of DSM mining in a context of the strong power imbalances and asymmetries that characterise the French Polynesian political economy and its relations to the French metropole. Besides the politics of time, the transparency issue is of the essence in a territory plagued by the secrecy disease [18] inherited from

the nuclear era. As it will be demonstrated, restoring trust (reducing moral uncertainty) and clarifying the rules of the game (reducing normative uncertainty) are crucial in this respect.

2. The french Polynesian context: looking for economic and political autonomy

The territory of French Polynesia comprises 118 islands, of which only 67 are inhabited. It has a population of less than 300,000, nearly two thirds of whom live on its main island, Tahiti. The territory is surrounded by a large EEZ covering approximately 5.5 million km². Colonised by France in the 19th century, French Polynesia has enjoyed broad autonomy since 1984, though the use of the atolls of Fangataufa and Moruroa as nuclear testing grounds from 1966 to 1996 implied a strong colonial tie. French Polynesia is currently undergoing a complicated period in its history, with difficulties arising in four main areas – the economy, politics, institutions and identity.

The territory is in the middle of a profound crisis triggered by the need to find credible economic alternatives to the annual payments received during the period of nuclear testing which ceased in 1996 [19]. The political situation has become extremely unstable, marked by volatility in political alliances and a short lifespan for administrations. From an institutional point of view, the country's autonomous status, reviewed in 2004, is contested by those in favor of full independence. In 2014, this group succeeded in having French Polynesia added to the list of seventeen non-self-governing territories of the United Nations' Special Committee on Decolonization. Since the 1980 s, there has been a strong movement to reconnect with local culture and identity [20]. These "politics of recognition" [21] impacts on how development projects, policies, and land disputes are negotiated [22]. A report from the French Senate released in 1996 [23] highlights the extent to which the territory's centralised structure is ill-suited to its geographic isolation and the social, cultural and natural diversity of its archipelagos.

Possible exploitation of DSM resources in French Polynesia would take place within this complex institutional context. It would also coincide with the search for development options (tourism, fishing, pearl farming, etc.) and strategic partnerships within the Pacific region, which will become one of the world's most important economic and geopolitical regions in the 21st century (as exemplified by the current US foreign policy). However, unless curtailed by periodical institutional volatility, the selected development options will shift the balance between political autonomy, the distributional impacts of socio-economic development, the management of various rents, and the composition of external financing flows accruing to the economy [24].

Public interest in DSM resources is relatively new to French Polynesia, although the topic has been discussed in the past within and between political parties but without resulting in any firm policy decision. In large part, this renewed interest was triggered by an article published by Kato et al. [25] in the journal *Nature* that incautiously evoked the presence of rich deposits of rare earth elements in Pacific seabed sediments and particularly in French Polynesia at a time of high prices (2010–11 supply crisis) of these elements. After the publication of the paper by Kato et al. [25], a strategic committee was appointed in 2011 with representatives of the French state and Polynesian government, allowing a renewal of discussions between the two bodies.

The territory has a specific history of on-land mineral resource exploitation, a history summed up in two names: Makatea and Mataiva. The phosphate resources of the Makatea atoll were mined from 1908 to 1966 [26] while those of Mataiva remain unexploited. The latter have been the subject of several studies but

the atoll's inhabitants rejected an operational plan in 2008. The limited mining on Makatea atoll had an onerous local impact, particularly in environmental terms, being based on a narrow mindset that cared little for the particularities of the territory or the sustainability of the mining operation.

Meanwhile, from 1966 to 1996, military nuclear testing were conducted in Moruroa and in Fangataufa, two atolls in the Tuamotu Archipelago, by the Pacific testing center based in Tahiti [27]. The creation of this center (located at the end of a strategic mineral chain) went hand in hand with financial transfers from the French government that drove modernisation and economic growth while encouraging the development of a system based on annual payments and clientelism. Although testing ceased in 1996, this system has resisted conversion to a more socially and environmentally sustainable economy. The lessons learned from this episode relate to the environmental consequences, the non-participatory and very opaque way that policies are implemented, and the resulting clientelistic forms of redistribution, among other things [27,28].

3. Governing mining in a non-independent territory: the legal and institutional framework

Transparency and public participation are paramount to democratic governance of DSM in French Polynesia. However, the issue is overdetermined by its status as a non-independent territory endowed with large autonomy since 1984. French Polynesia has primary jurisdiction by virtue of article 13 of the Organic Law of 2004 [29], the government and municipalities being endowed with statutory jurisdiction. With regard to jurisdiction in the area of mining, it seems that while French Polynesia possesses statutory competence over its mineral resources by virtue of article 47 of the Organic Law, the French government retains residual jurisdiction for metals considered “strategic” under the French Mining Code. However, there is no legal definition for the term “strategic metals”, unless we consider the finding of 14 April 1959, which is of uncertain legal soundness, not being a decree. The European concept of “critical metals” is not relevant here. There is a European list of critical metals that was published in 2010 and revised in 2014. This document, which is to be revised again in 2017, is intended solely for informational purposes and possesses no legal status [30].

In all events, the allocation of competences must be addressed with specific reference to exploring and exploiting Polynesian DSM resources. The legislation currently refers to a residual jurisdiction for the French government for “strategic metals” which are categorized as “substances needed for atomic energy (helium, uranium, thorium, beryllium, lithium and their composites)” and liquid and gaseous hydrocarbons – as re-asserted in the current process of revision of the French Mining Code and contested by French Polynesian leaders (see for instance the proposal of new organic law (no. 473 of March 9, 2012) made by the pro-independence senator Richard Tuheiava to abolish this residual competence). On this basis it can be concluded that the residual jurisdiction of the French government does not apply to the ores identified on the Polynesian seafloor.

While the allocation of jurisdiction between France and French Polynesia attracts attention due to its political dimension, it is in another field that the most decisive legal changes will take place; namely in the area of higher-order standards imposed on French Polynesia in the exercise of its mining competence. As with the French national Mining Code, the provisions set out by the French Environmental Charter of 2004 [31] require modifications to the Polynesian Mining Code, including specific changes relating to underwater activities. With so little known about the

environmental impact of DSM mining, the constitutional principles of prevention and precaution set out in the Environmental Charter should be applied more strictly than for onshore mining activities, so long as a balance can be struck to avoid blocking the activity altogether.

Besides this imperative, the creation of a framework that appeals to economic operators is undoubtedly one of the main incentives for updating the Polynesian Mining Code. An attractive framework requires predictable and stable regulations and the implementation of taxation specially adapted to the nature, extent, duration and risky character of mining projects. Given the still experimental nature of DSM mining, a reform of Polynesian mining law could be, *inter alia*, guided by: (i) the principles laid down at international level by the International Seabed Authority [32], (ii) the Regional Legislative and Regulatory Framework, developed by the SPC-EU DSM Project [33], (iii) feedback from other ongoing or recent projects in place, (iv) instruments developed by neighbouring countries (e.g. Cook Islands and Tonga) [34]; and (v) the “best practices” and voluntary guidelines developed in the oil and gas industry [35].

4. Defining and situating deep-sea mineral resources in French Polynesia

4.1. Defining DSM resources: geology, sustainability

A mineral resource is a concentration or occurrence of one or several minerals situated on or in the Earth's crust with a form, content or quality that offers reasonable prospects for profitable extraction. This simple definition, employed by the mining sector and international bodies, has long been challenged and modified in the field of social sciences by economists [36], anthropologists [37] and geographers [38], who highlight the relational and socially constructed nature of the resource, through various abstract, practical, commercial and technological approaches to the idea of the resource, as opposed to the natural “material”. Even though understanding French Polynesia's DSM resources is a prerequisite to any decision about exploitation, the recognition of DSM mining in all its dimensions, including cultural aspects, is needed to design a relevant, well-dimensioned policy tailored to the country's needs. The choices of administrative set-ups (for example, creation of a dedicated mining authority) and institutional arrangements (e.g. creation of a marine agency that includes mining, as opposed to maintaining separate sectoral policies regarding mining, fisheries, and the environment) would benefit from the recognition of the interrelated nature of these dimensions. Therefore, an assessment of all existing knowledge is needed – knowledge that is very diversified both from a disciplinary perspective and in terms of informed stakeholders. The task is particularly complicated because information on the resources remains incomplete, various economic and environmental factors are uncertain, and the rules governing the allocation of mining revenues among the various stakeholders have yet to be defined. The value attributed to a mineral resource by the various actors in a mining project is the outcome of different levels of analysis.

This last point is of particular relevance for the appraisal of DSM mining from a sustainability perspective. Following a weak sustainability perspective that assumes a complete substitutability between forms of capital, and good governance should ensure the transformation of the wealth extracted from the seabed and subsoil into human capital (e.g. school funding, training) and economic capital, thus ensuring the transmission of the same amount of wealth to future generations [39]. Furthermore, a weak sustainability analysis rules out all cultural and heritage aspects, only some of which can be measured in monetary terms [40]. To ensure

sustainability, clear and equitable rent-sharing rules (including taxation rules) are necessary - but not sufficient per se. Ensuring that an equitable share of the mining revenues accrues to the government budget does not ensure that it will be used to finance sustainability. Dedicated sovereign funds can represent a useful mechanism in this respect [41]. A strong sustainability approach highlights the risks of irreversible environmental damage caused by DSM activities. Geological formations on the seabed are analysed in terms of 'critical' natural capital, with a heritage dimension (biodiversity, culture) that is related to environmental, cultural and social values rather than economic monetary value. Such an approach stresses the need for environmental protection mechanisms allowing recognition of the cultural and social impacts of the activity.

Knowledge of French Polynesia's DSM resources is very limited, both in terms of the overall coverage of the EEZ and of the quality of available information. Information collected during the Nodules and Nodco campaigns in the 1970s and 1980s yielded encouraging signs pointing to the existence of valuable minerals. The EEZ was explored to a very limited extent during the Zepolyf program in the 1990s, using the methods available at the time [42]. Of these discoveries, the most notable are polymetallic crusts which are exceptionally rich in cobalt, and observed on seamounts on the Tuamotu Plateau, mainly at depths of 800–2500 m [43]. These crusts have some of the highest concentrations of cobalt (> 1%; [17]) ever found on the ocean floor. Other observations suggest the presence of abundant (> 35 kg/m²) polymetallic nodules on the abyssal plains north-west of the EEZ [44]. Phosphates have also been found in the form of phosphorite in the substratum of polymetallic crusts [45]. However, at present, it is impossible to say whether valuable metals can be extracted in an economically and environmentally acceptable manner, and therefore whether these deposits constitute a potential resource. Further DSM research and exploration are needed before their status as potential DSM resources can be established.

4.2. *Situating the DSM resources: ecology, society, economy*

It is also important to highlight that the geological knowledge of the resources has to be placed in a broader context, considering: (i) the marine habitats and ecosystems that have formed in its vicinity and; (ii) cultural representations of the marine environment. In that regard, it should be worth mentioning that the two potential resources occur in different geological contexts. The polymetallic crusts form on the side of seamounts or the tops of guyots (volcanic seamounts with flat tops), whereas polymetallic nodules are largely restricted to abyssal plains. The thickness of the crusts remains unknown but exploitation may involve considerable surface areas depending on the rate and duration of mining. The technology for crust mining is yet to be developed, and is anticipated to be more complicated than for nodules due to the nature of the mineralisation. Instead of loose nodules in unconsolidated sediment, polymetallic crusts consist of a thin layer of relatively hard material that will need to be cut away from underlying rocks. As for their biological context, an important feature of marine environments is an interdependence between compartments that are far removed from one another, either vertically (along the water column) or horizontally (between distant sites). These linkages are important for the life cycles of organisms, which can include phases in different compartments of the water column and also depend on trophic connections between the different compartments [46]. Almost nothing is known about the organisms and habitats that would be directly impacted by DSM activities in French Polynesia and little more is known at

global level [47]. The seamounts are, however, well-known to fishermen as they have higher concentrations of pelagic organisms and predators. The ecology of large marine vertebrates – birds, mammals and fish – is better documented than that of benthic invertebrates. Based on the seasons or the stages of their life cycles, many of these pelagic organisms travel across vast maritime areas that may extend from cold waters south of New Zealand all the way to the Marquesas Archipelago. This raises tricky questions about the perimeter to be taken into account when trying to assess the potential impacts of DSM mining. The problem is the same for benthic fauna. The biology of these organisms usually involves a mobile pelagic phase that enables them to disperse between far-flung favourable habitats [46]. Besides, most of these organisms have long lives and act as ecosystem architects [49]. This long lifespan is made possible by long-term stability of the geological substrate, which is one of the factors that allow crusts to form. The little data available [50] does not allow the ruling out of the possibility that the fauna associated with crusts are different from those associated with non-encrusted seamounts. The answer to this question is crucial when it comes to formulating a plan for managing and protecting deep-sea fauna impacted by potential exploitation.

The nature-culture relationship in Polynesia is seen as genealogical, following a principle of continuity where gods and humans are genealogically related to nature, which includes the mineral world [51]. Plants and minerals can be considered an extension of kin or as a manifestation of the divine in the visible world. In this respect, mining for mineral resources is not only an industrial process of material extraction but also an act of cultural extraction or dis-embedding. Recognising the cultural sensitivity of marine habitats is an essential prerequisite to the development of any activity likely to affect that environment. It is also vital in this context to take into account the very active policies on identity and cultural recognition in French Polynesia, in place for the last couple of decades [20]. Recognition of these factors is essential for understanding and perhaps predicting how the possible development of DSM activities may be received and possibly adopted in local political arenas. This active mobilisation of identity and culture must be distinguished from every day, individual and collective, cultural representations and practices concerning the environment and reproducing the Polynesian nature-culture continuum.

The profitability issue, which is beyond the scope of this paper [53], could be conceived as a third form of contextualisation. At present, the economic literature on the profitability of the exploitation of polymetallic crusts is strongly limited by many uncertainties – on the prices of raw materials, on current global market prices, on geopolitical hazards (most of the cobalt production is located in the Democratic Republic of Congo and extractive metallurgy plus refining in China), on technology, on the environmental impacts, on the legal requirements related to exploration and exploitation, and finally on the geological characteristics of undersea formations (i.e. thickness, continuity, metal grades, metallurgy, etc.). Given these uncertainties, the profitability of DSM mining is far from being assured [54]. In French Polynesia, the element that forms the basis of future profitability is cobalt (as well as other metals such as copper and nickel and perhaps platinum, manganese, titanium and other minor metals). However, a combination of high concentrations of cobalt [55], very favourable assumptions for the cobalt price (60% higher than the average for the last 30 years) and high-volume mining (10,000 t, 10% of the world supply) must be met for DSM mining of polymetallic crusts to be profitable [56].

5. Framing an inclusive governance of DSM activities and redressing asymmetries

5.1. Participation and the time factor

The complex definition of the geological, social, environmental and spatial perimeter of DSM activities and impacts renders the design of inclusive governance of the sector difficult but essential. Adaptation of the legal framework governing mining of DSM is necessary but not sufficient. It is noteworthy that the 2004 Environmental Charter (integrated into the French Constitution) emphasizes the principles of prevention, public information and participation.

The time factor plays a vital role when organising participation in a mining project and, more broadly, in implementing public policy in this area [57]. It is a matter of anticipation and adaptability. As regards to anticipation, the earlier the participating process is planned, the more influence it has on the decision. This is why it is extremely important to provide mechanisms for participation, bearing in mind that the debate may not necessarily take place in the settings envisioned by public authorities. Despite its difficult implementation, free, prior and informed consent (FPIC) plays a central role here [58], as it leads to a system based not on consultation but on consent, which must be expressed before a decision can be made. In this respect, the good thing is that French Polynesia has started tackling the DSM mining issue well in advance, before any permit for exploration or prospecting has been issued or even applied for. Adaptability is also key because a program of exploration and mining takes place over a long period of time, so the issues, risks and benefits will vary over time. The key moments when it is necessary to involve stakeholders must be identified, while taking into account technological developments that might require the project to be re-evaluated.

Given the vast extent of potentially mineralised portions of the Polynesian EEZ, it is highly likely that any DSM mining would take place far from the coast and well away from centres of population. Though making it more difficult to determine the 'scope of the public' affected, this does not make the issue of social acceptability any less challenging [59], the dual continuum of land/sea and culture/nature being so important in French Polynesia.

In any event, a first step entails mapping all stakeholders who may be potentially affected as well as their expectations and concerns [60]. It is also necessary to identify and evaluate pre-existing arenas for debate, in order to mobilise them as part of the project and avoid multiplication of artificial and ad hoc forums and debates: in other words, taking account of the unavoidable embedding and re-interpretations of exogenous projects in local politics [61]. Given that future DSM mining will most likely be located in the open oceans, the number of stakeholders directly affected will be smaller than for onshore mining but the identification of the 'affected community' could be more difficult than for terrestrial mining. Nonetheless, in the context of a democratic society, of increasing institutionalisation of heritage (of nature in particular) extending beyond a circle of directly affected stakeholders, of the increasing dissemination of information through formal and informal communication networks, and of the specific nature-culture relationships in Polynesia, it is likely that various stakeholders, or their representatives, will express specific concerns and expectations depending on their perceptions and agendas.

Setting aside civil society and various public authorities, fishing remains a key issue, because the waters that contain potential mineral resources also possess significant biodiversity. Longline fishing would be therefore the most affected, though other forms are also concerned. Coastal, and even lagoon, fishing could be affected and it is therefore worthwhile considering the concerns of all stakeholders in the fishing sector. The oyster pearl industry

mainly localised in the Tuamotu and the Gambier Archipelagos could be affected by sediment plumes. Other activities can also be identified, such as tourism. Mining activities might lead to degradation in water quality (suspended particles) and in aesthetics (structures built for exploitation) at a time when nautical tourism (unlike onshore tourism) is booming in French Polynesia. Lastly, the shipping and cruise sectors (another form of tourism) might also be affected by DSM mining projects. It should also be noted that the scientific value of these areas is demonstrated by the large number of research organisations present there (including most of the French public research institutions, the University of French Polynesia, The University of Berkeley). The potential impacts on these activities must be carefully assessed, taking into account the fact that mining activities would take place on limited spaces representing a very small fraction of the Polynesian EEZ (maybe 100 sq km in a total area of about 5.5 million sq km).

Environmental issues, and the associated stakeholders and tools, will be subject to specific focus in the debate likely to arise over mining. French Polynesia contains 32 protected and/or managed natural areas spread over 15 of the islands in the Society, Tuamotu and Marquesas Archipelagos. These include various marine or marine/terrestrial reserves and a diverse array of projects at various stages of development, which could all have an impact on the exploration and exploitation of DSM resources and vice versa. This general issue also applies differently to different locations, depending on the particular cultural or ecological conditions of the Polynesian archipelagos and their vulnerability, as well as on existing environmental initiatives and their potential integration into a marine spatial planning policy. Most notable are the creation of an extensive marine protected area in the Austral Islands supported by the international NGO Pew but contested by the Polynesian government (see *supra*), the process of inscription of the Marquesas as a UNESCO World Heritage site, and the establishment of a biosphere reserve in Tuamotu (Fakarava).

5.2. Redressing asymmetries and crafting transparency

The crafting of inclusive governance is also a matter of managing imbalances and asymmetries. The situation created by a major mining development in a small country involves the following risks of imbalance and dependence: (i) the flows of financial and material resources enabled by a mining project are considerable and are capable of generating various active rent-seeking strategies; (ii) the technology brought in for a mining project is often imported and not well mastered by local agencies; (iii) the influx of resources generated by a mining project is often accompanied by an absence of norms and therefore a high level of normative uncertainty concerning the 'rules of the game'. A fourth dimension of uncertainty is moral and endogenous to French Polynesia's colonial history in relation with the French nuclear power and its politics of secrecy [18,62].

A policy of transparency can contribute to redress the power imbalances occurring at various levels. The dissemination of (clear and accessible) information and consultation with/participation of local populations must be organised early on in order to avoid presenting the affected individuals with an actual or perceived fait accompli. This political necessity – transparency – must work against any tendency towards concealment, which generates suspicion [63] and mistrust – a form of moral uncertainty – that are quite difficult to combat once they have taken root. In French Polynesia, however, this tendency is firmly entrenched, as a result of the secretive policy that surrounded the nuclear undertakings of the French military. This legacy weighs heavily and the slate has not yet been wiped clean.

Transparency is also needed to identify and settle conflicts of interest. This issue requires careful attention, because the biases

that could arise are strong and hard to rectify. They include various forms of corruption which may look for justification in culturally accepted practices and develop into an entrenched culture of corruption. Conflicts of interest can take many forms. The main categories can be identified based on contradictions between functions, such as evaluators and operators or regulators and shareholders. Resolving functional conflicts involves designing, implementing and monitoring a whole set of administrative procedures, sectoral distinctions, and judicial measures – *in fine* policy decisions combined with mechanisms of accountability.

All this pleads for developing a strategy of institution-building that favours autonomy, in particular the creation of an independent mining authority. The Cook Islands and Tongan experiences could be useful here, despite (or because of) their shortcomings [64]. Policy responses should also be designed to take into account the choices made concerning mineral processing. There are various options ranging from processing taking place entirely in, or outside Polynesia. In the former case processing could take place on land (implying adapted onshore port facilities) or offshore (on a platform or floating island, in order to limit environmental impact). One must be cautious here as it could also be argued that on land processing can be better organised and monitored, with the consequence that the potential environmental impacts may be less than at sea.

The issue of monitoring and evaluation is also a crucial (and all too often) underestimated part of policy-making. Its effectiveness depends on the existence of a clearly defined political strategy. One of the main problems for evaluating and monitoring the environmental impact of DSM mining is identifying at which scales, both vertical and horizontal, the marine ecology may be impacted. Only a strategy for knowledge acquisition with spatial priorities and covering all the biological compartments of the water column would make it possible to identify the relevant scale to be employed in environmental impact studies and monitoring. This knowledge should then be evaluated in the framework of models for the scale, depth and degree to which mining would affect the surroundings. The environmental issues and impact of DSM mining activities are not solely ecological; they are also social and cultural, due to the Polynesian understanding of a nature-culture continuum. As such, they are not localised at the areas being mined, but instead extend spatially across distances that are sometimes quite vast. They are closely linked to the question of use and representations of the marine area. Monitoring and evaluating the changes brought about by DSM mining therefore should not neglect socio-environmental issues, knowing that social impact assessment remains all too often “the orphan of the assessment process” [65].

Monitoring and evaluation also leads back to issues of participation and consent. It would be a mistake to perceive prior, free and informed consent (PFIC) as a transaction that happens once at the beginning of the project, settling for good the issue of consent from potentially affected populations. Implementing the concept of FPIC can be problematic [58,66] and it must be thought of as a political and moral instrument that ties the stakeholders to a set of rights and obligations. These must be clear, and they can also be re-evaluated based on events that change the landscape to an extent recognised by all parties (in accordance with defined procedures). The ability and opportunity to express opinions (including dissenting voices) must be assured for the long term. At a minimum, obligations of transparency, extensive reporting on social, economic, environmental and governance outcomes, and a mechanism for settling conflicts must be anticipated. In other words, FPIC is not merely a necessary preliminary step but instead a process to be actively maintained throughout a mining project. As such, it is a part of the monitoring and evaluation mechanisms.

6. Concluding remarks: Competing timeframes, power asymmetries and uncertainties in DSM governance

The situation seems ideal in French Polynesia, in that no DSM mining is currently taking place and no exploration permits have been granted (contrary to other countries within the Pacific Islands region) [64]. This means there is time to decide in an informed manner whether to mine or not. If the first option prevails, it will be possible to create an original and inclusive DSM mining policy, tailored to the realities in the country and to support forms of regulation gradually implemented through the array of actors and institutions.

However, there is a significant risk that the Polynesian government could be overwhelmed by the expert capabilities (technical, economic or even legal) of its partners or by the scope of the issues (particularly in politics and economics). This could result in a classic situation of “right without access” [68] in which the legal jurisdiction cannot compete with the financial, technological and human capital injected by transnational mining companies. In the same vein, “regulatory science” [69] like the expert group review at the origin of this paper, has to compete with intruding “corporate science” [4]. The “right-without-access” asymmetry also applies for the government-corporation face-to-face but also at another level for the relations between the French metropolis and the Polynesian overseas territory: the latter has the legal competence but the former can mobilise the French nexus of research and industry.

Furthermore, the possible launch of DSM mining in French Polynesia would set in motion a complex set of timeframes and generate specific risks and uncertainties; in other words “the unbridgeable gap between time scales of concern and impact” [5: 153]. These gaps are conceptualized by Barbara Adam’s “timescape perspective [that] conceives of the conflictual interpenetration of industrial and natural temporalities as an interactive and mutually constituting whole and stresses the fact that each in/action counts and is non-retractable” (1998: 56). But there are more than industrial and natural timescapes. Mining projects take place over long periods of time, including the highly uncertain exploration period (only a small fraction of mining projects ever get past this phase) and result in massive flows of resources and players over several decades of operations and post-operational work. It is important that a clear legal framework, accepted by all parties, is established before this stage commences, and that all engagements are respected. “Moving the goalposts”; i.e. adopting more stringent constraints after considerable investment has gone into the exploration phase will dissuade investors whose contribution is essential for the more costly exploitation to go ahead. This time period is taken into account economically and, to that end, the issue of investment costs for exploration is particularly relevant. The exploration period and the time for acquiring, processing and making use of the necessary data is part of a scientific timescape.

These business and scientific timeframes are confronted with ecosystems where events occur at an entirely different pace. Polymetallic crusts are found in habitats that are still not well understood; except that they are open, connected to their surroundings and also highly specialized. These habitats take a long time to establish themselves, so their resilience is likely quite low and the speed at which they regenerate after being disturbed or partially destroyed is certainly quite slow. Institutional and policy changes take place in a variety of time periods: the relatively short term of electoral mandates, the sometimes rapid pace of transfers of power, the longer term of political networks, and the inertia of regulatory frameworks. Finally, the Polynesian people have inherited a long cultural past and a collective historical memory; at the same time, they are preoccupied with daily necessities and concerns for future generations. This means that each social actor operates in several different timeframes at once.

These societal, ecological, political and industrial timeframes are not only diverse, and sometimes even contradictory; they are also subject to a number of uncertainties, ranging from risks that are more or less quantified to absolute unknowns [70]. The lack of knowledge cuts across all stakeholder groups involved in the potential mining arena. However the consequences and impacts of the decisions and actions to be taken are not the same for all.

This situation requires caution: this does not mean inaction, but rather the implementation of the principles of precaution, deliberation and accountability. At stake here are the politics of time - anticipation, monitoring, adaptability, sustainability - and the politics of space: defining the complex perimeter of DSM activities and impacts and the social arenas and alliances to deal with them.

Acknowledgement

The authors are members of the expert group led by the Institute for Development Research and commissioned by the French Polynesian and French governments to review the current state of knowledge on DSM deposits in French Polynesia and propose policy recommendations. We would like to warmly thank the other team members: Tamatoa Bambridge and Pierre Cochonot for their astute comments and careful readings of the text, as well as Carine David, Christian Jost, Sarah Samadi and Antonino Troia-niello for their excellent contributions to the expertise.

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