



History matters: societal acceptance of deep-sea mining and incipient conflicts in Papua New Guinea

E.I. van Putten^{1,2} · S. Aswani³ · W.J. Boonstra⁴ · R. De la Cruz-Modino⁵ · J. Das^{6,7,8} · M. Glaser^{6,8} · N. Heck⁹ · S. Narayan⁹ · A. Paytan¹⁰ · S. Selim^{6,11} · R. Vave⁹

Received: 11 August 2022 / Accepted: 2 June 2023 / Published online: 3 July 2023
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Abstract

New marine industries that develop and grow in response to the changing demand for their products have the potential to exert pressure on fragile marine environments. These emerging industries can benefit local communities but equally can have negative environmental and socio-cultural impacts. The development of new and emerging industries, like deep sea-bed mining (DSM), requires the acceptance and involvement of local communities. Yet, the history of marine exploitation is imbued with conflicts between industries and local communities. This paper presents a DSM case study in Papua New Guinea (PNG) to stimulate debate around the potential for conflict in the pursuit of resource extraction from the deep sea and the social and environmental harm that these extractions can cause. We do so by first presenting a timeline of local and extra-local events and enabling conditions that form the development background for the DSM Solwara 1 project in PNG. We then undertake a media narrative analysis to consider the contribution of aspects of social acceptability to this highly complex and multi-scale conflict. We find that the lack of (or a decrease in) social acceptability contributed to the conflict situation and ultimately the demise of the Solwara 1 project. Extra-locally, the initial development was positively framed around solutions for decarbonisation using new technology. Over time, actions by international NGOs, financial issues related to foreign companies, and asymmetry in the power balance between the Pacific Island nation and global businesses played a role in growing negative perceptions of acceptability. Historical experiences with prior environmental mining disasters, together with sea tenure governance challenges, and a lack of community and stakeholder acceptance also contributed to the demise of the project. Untangling and debating these complex interactions provides context and reasons for the tension between the lack of societal acceptance at a local scale and the perceived need for DSM products in the global North for innovative technologies and decarbonising societies. Better understanding these interactions and tensions can help emerging industries navigate a future blue economy.

Keywords Deep sea · Mining · Papua New Guinea · Social licence · Marine conflict

✉ E.I. van Putten
Ingrid.vanputten@csiro.au

¹ CSIRO, Environment, Hobart, Tasmania, Australia

² Centre for Marine Socioecology, University of Tasmania, Hobart, Tasmania, Australia

³ Rhodes University, Grahamstown, South Africa

⁴ Uppsala University, Department of Earth Sciences, Uppsala, Sweden

⁵ Institute of Social Science and Tourism, University de la Laguna, 38200 La Laguna, Spain

⁶ Leibniz Centre for Tropical Marine Research (ZMT), Fahrenheitstraße 6, Bremen, Germany

⁷ Institute of Marine Sciences, University of Chittagong, Chittagong, Bangladesh

⁸ Institute of Geography, University of Bremen, Bremen, Germany

⁹ Department of Coastal Studies, East Carolina University, Greenville, NC, USA

¹⁰ University of California Santa Cruz, 1156 High St, Santa Cruz, USA

¹¹ University of Liberal Arts Bangladesh (ULAB), Dhanmondi, Dhaka 1209, Bangladesh

Introduction

With the increasing demand for resources, particularly those needed to help realise the technological innovations for sustainability transformations, there has been an expansion of economic activity in marine environments as part of the blue growth push (Jouffray et al. 2020). The combination of increasing marine resource use and growing environmental pressures ignites and drives conflicts around access to and control over these marine environments (Childs 2020b, Bennett 2018, Bennett et al. 2019). Environmental and sustainability concerns have been raised over the years for many conventional economic activities in marine environments, such as fishing and aquaculture or oil and gas production (Worm 2016). More recent user activities related to the production of renewable energy (offshore wind), and extractive activities like sand mining, are running into similar concerns (Levin et al. 2020).

Deep seabed mining (DSM) is an emerging maritime user activity that is “moving towards the threshold of commercial viability” (Carver et al. 2020, p.2). Even though exploitation of deep seabed mining products is not yet common, considerable concerns about biodiversity losses (Niner et al. 2018) and potential environmental and social impacts have already been raised (Carver et al. 2020, Childs 2020b), in addition to geographical, geopolitical, legal, and political economy concerns (Carver et al. 2020).

The combination of high economic gains and deep social and environmental concerns form a frequent source of conflict (Harris et al. 2018, Cánovas-Molina and García-Frapolli 2020, Kaikkonen et al. 2018). We define conflict as active disagreement that may manifest in different ways (Alexander 2020). We use an example from Papua New Guinea (Solwara 1 project) where high concentration of marine metal deposits was perceived as commercially viable given current prices for those metals. We focus on a low-intensity, non-violent conflict that has been described as preventative resistance (Environmental Justice Atlas 2020). The conflict occurred at the regional scale between different local and extra-local stakeholder groups and a foreign company (Canadian owned, Nautilus Minerals Inc.). Studying the roots and development as well as potential resolutions of these conflicts and to consider the costs and benefits of this industry will help ensure sustainable co-benefits for humans and nature while safeguarding social and environmental justice.

We use our case study to illustrate how different aspects of social acceptability and local and extra-local events indicate that timing and history are also important as a causal factor for the development of conflict in DSM (Childs 2020a). We undertake this analysis to stimulate debate around DSM as there is a need to navigate the dilemma between, on the one hand, the perceived need for resource extraction as input for the sustainability transformation and decarbonisation and, on

the other hand, the risk of social and environmental harm these extractions can cause (Childs 2022). We combine a historical timeline of events and a social licence framework (Robinson et al. 2021) to highlight critical junctures and tipping points in the conflict over DSM in PNG. This analysis goes beyond the usual treatment of social licence to operate (which we will refer to as societal acceptance) and unravels consequential events in the history of the conflict.

Theoretical approach

Societal acceptance¹ entails public, stakeholder, and community approval or favourable evaluation of industry or government using or developing common-pool resources. Theoretically, the societal acceptance of a project (undertaken for example by a business, industry, or public institution) means that there is a level of acceptance and approval of its standards and operating procedures (Dreyer and Walker 2013). Key to societal acceptance is trust, legitimacy, transparency, and credibility of the proponent. Trust, legitimacy, and credibility can be difficult to build but very easily lost (Jijelava and Vancly 2017). Meaningful engagement processes can help build trust and reduce the potential for conflict (Mercer-Mapstone et al. 2017).

In this research we link a *lack of* societal acceptance to an increased potential for conflict. When there is a lack of societal acceptance, for example through a lack of legitimacy, credibility, and trust (Moffat et al. 2016) and where there is no avenue or attempt for this to be built, conflict may result (Voyer and van Leeuwen 2019). We do not argue that the presence of societal acceptance means there is no potential for conflict, but merely that when there is an absence of societal acceptance, the potential for conflict is high, and indeed a causal relationship exists between the two. The absence of societal acceptance can be an indicator of past, current, or potential future (latent or active) conflict (van Putten et al. 2018, Kelly et al. 2017, Moffat et al. 2016). We also highlight that conflict does not necessarily have to be perceived negatively because it can serve a purpose (Hirschman 1994). For example, local resistance can potentially improve industrial operating standards and procedures and contribute to achieving better environmental and social outcomes in the long run.

When unpacking societal acceptance (Robinson et al. 2021), it is evident that the concept contains many different aspects (Filer and Gabriel 2018). In this paper, we loosely define three dimensions that together provide or withhold societal acceptance of industry: civil society, the governance system, and the market (Fig. 1).

¹ We use the term societal acceptance but acknowledge there are slight definitional differences with the terms social licence and societal approval as discussed in Robinson et al. (2021).

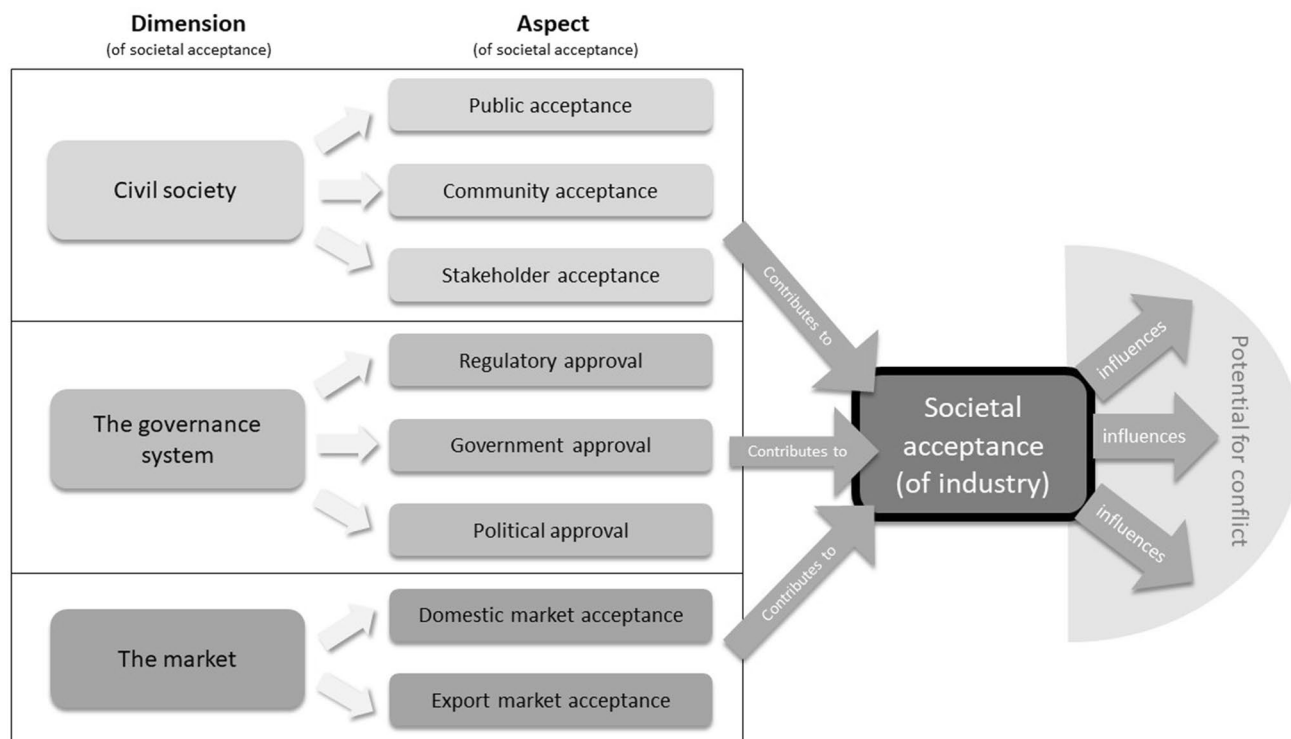


Fig. 1 Schematic representation of three different dimensions and eight aspects that together represent societal acceptance of industry. This is a family resemblance construction (Goertz and Mahoney 2012) which indicates that not all aspects are always needed to

achieve societal acceptance. The potential for conflict (right hand side) is influenced by the “state of” societal acceptance (of industry) based on (Robinson et al. 2021)

Firstly, societal acceptance is provided or withheld by civil society (or groups of people). Commonly, these different societal groups include the public, community, and stakeholders (Robinson et al. 2021), and there is some overlap between them. Stakeholders are defined as those who have a direct economic (e.g. fishing rights), social (e.g. recreational use), or cultural (e.g. spiritual use) relationship with the environment, development, or industry. The community may not have a direct interest like stakeholders, but are geospatially located in the industry development region, whereas the public does not necessarily have a geospatial relationship (i.e. they can be in a different region, state, or even country). Considering these different levels of society allows for differences in perspectives on industry legitimacy and aspects of trust to be recognised, depending on people’s social position in relation to the environment under development. Therefore, we divide civil society’s acceptance into three aspects: *public acceptance*, *community acceptance*, and *stakeholder acceptance* (Fig. 1).

By including these three civil aspects of societal acceptance, we tacitly acknowledge that the creation of a social licence is achieved by a network of groups in society. This includes groups who maintain an indirect economic, social, or cultural interest but who might not be physically

located in the immediate geographic community or hold a direct stake (Roche and Bice 2013). The question of who represents society is thus not answered (Filer and Gabriel 2018) but leads closer to an inclusive approach. Inclusivity remains a difficult concept because societal acceptance is usually granted on a site-specific basis, which makes it especially complicated for DSM. As stated by Filer et al. (2021, p.102): “it is difficult to argue that exploitation will directly affect the livelihoods of indigenous communities especially at the bottom of the ocean since there are no human actors, indigenous or otherwise, who are already ‘down there’ before exploitation begins”. Similarly, Childs (2022) highlights that DSM takes place “in novel geographies that are rendered materially and emotionally in different ways by various human actors unable to physically encounter the socio-political terrain at stake”. Filer and Gabriel (2018) highlight that “PNG government officials have consistently maintained that the seabed cannot have any ‘landholders’ apart from the State itself” (p.396). It is useful to highlight that even those people who do not have any consistent interaction with the deep sea do care for it (Kaikkonen and van Putten 2021).

The second dimension to societal acceptance of industry concerns governance (Fig. 1). This dimension is made up of

three aspects: *regulatory approval*, *government approval*, and *political approval*. Formal (or official) approval, which we refer to as *regulatory approval*² of industry operations, is met through specified (and measurable) requirements that are set out in regulations or rules of conduct (i.e. instance licences and authorisations, which can be legally binding, that are obtained from the regulatory authority). *Government approval*, and support for industry, is based on their current policies and agendas outside of formal regulations. *Political approval* is approval given by civil society to the government and associated regulatory processes through the political process (i.e. voting). By means of voting, a government comes to power and this government then gives approval to the industry (i.e. mining company). Society thus gives indirect approval (via the political process) and not directly to the industry.

The third dimension of societal acceptance relates to the market and the acceptance of industry by consumers, retailers, or investors. This *domestic* and *export market* acceptance is indirectly given by virtue of the products bought and traded (e.g. consumers buying the industry products and banks providing loans to the industry).

By looking at these three dimensions of societal acceptance, we acknowledge that the causal pathway from environmental change to social conflict is shaped through a combination of environmental changes interacting with political, economic, and social factors—including institutions, power, and knowledge (Kung et al. 2021). To understand these causal pathways, it is essential to consider the historical and current context within which the social changes are taking place, and the interaction between these changes and conflict.

To gain a deeper insight into how aspects of societal acceptance contribute to conflict, we trace the development of conflict around DSM in PNG backwards in time to explain the effect of events, people, processes, and conditions (Bunge 2004, Fall-eti and Lynch 2009). We do not have adequate data to apply process tracing (Spijkers and Boonstra 2017, Andrachuk and Armitage 2015, Berkes et al. 2003, Boonstra et al. *this issue*), which is a method that sequentially orders events to discover how causal interactions might lead to the outcome of interest (Walters and Vayda 2009). But in accordance with process tracing, we identify events (sometimes called turning points, critical junctures, or watersheds) that have shaped the development of the conflict around DSM in PNG (Beach 2017, Levy 2015).

Development and governance of deep-sea mining

There are several mineral deposits (polymetallic sulphides, polymetallic nodules, and cobalt-rich ferromanganese

crusts) under and on the ocean floor that are rich in metals important for technological innovations for sustainability transformations. DSM is used to exploit these resources. The idea of DSM dates back to the 1960s and was made possible by increasing knowledge of the sediment composition of the deep ocean. There was a resurgence of interest in DSM in the 1990s when DSM technology became sufficiently developed, and exploration and exploitation costs were falling (Van Dover 2010). At that time, general bathymetric charts had been developed for the world's ocean, Geosat satellite radar data was declassified allowing for high-resolution global maps of the seafloor, and Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) became available as support equipment. Nowadays, the increasing commercial interest in DSM is driven by a desire to geopolitically claim the ocean floor (Carver et al. 2020) and an increased demand for energy supply from renewable sources (Christiansen et al. 2020). The increased demand for batteries is a particularly strong driver; many of the metals needed in the manufacturing process are abundant on and under the seabed. It is important to note that there is extensive debate around the need for DSM minerals for a green transition, and whether this transition can be satisfied through technological innovation or, for example, recycling (Miller et al. 2021, Childs 2019, Hein et al. 2020). Mining on land and in the deep sea is often carried out only by large businesses due to the technological requirements and the size of investment (at exploration and exploitation stages) (Christiansen et al. 2020).

DSM activities can occur within the Exclusive Economic Zones (EEZ) of national jurisdictions or beyond the boundaries of such jurisdictions (Willaert 2020). Half of the global seabed minerals are within EEZs³ and thus fall under national jurisdiction. The International Seabed Authority (ISA) was established under UNCLOS 1982⁴ to regulate human activities on the deep-sea floor in areas beyond national jurisdiction (Miller et al. 2018). The ISA DSM implementation agreement was signed in 1994. Regulations on exploitation (currently in draft status) will include environmental principles, rules, and procedures. In

² Here, we use the wording used in Robinson et al. (2021) (i.e. approval).

³ 2011 Society for Mining, Metallurgy, and Exploration, Inc. <https://ct.moreover.com/?a=24330507008&p=8zs&v=1&x=c6LIF0WL5g5VH0vq8JekZg> accessed 17.1.2023

⁴ Over 160 countries have ratified UNCLOS, but the USA has not. US companies can obtain exploration licences for polymetallic nodules from the National Oceanic and Atmospheric Administration (Modak, P., Mathur, A., Vaidyanathan, K., et al. (2019) Mainstreaming natural capital valuation. Paper presented at the T20 Summit 2019: International financial architecture for Stability and Development / Crypto-assets and Fintech, Tokyo, Japan. Available at: <https://www.gatewayhouse.in/wp-content/uploads/2019/04/t20-japan-tf2-14-mainstreaming-natural-capital-valuation.pdf>.) (NOAA) under the Deep Seabed Hard Mineral Resources Act of 1980 (DSHMRA).

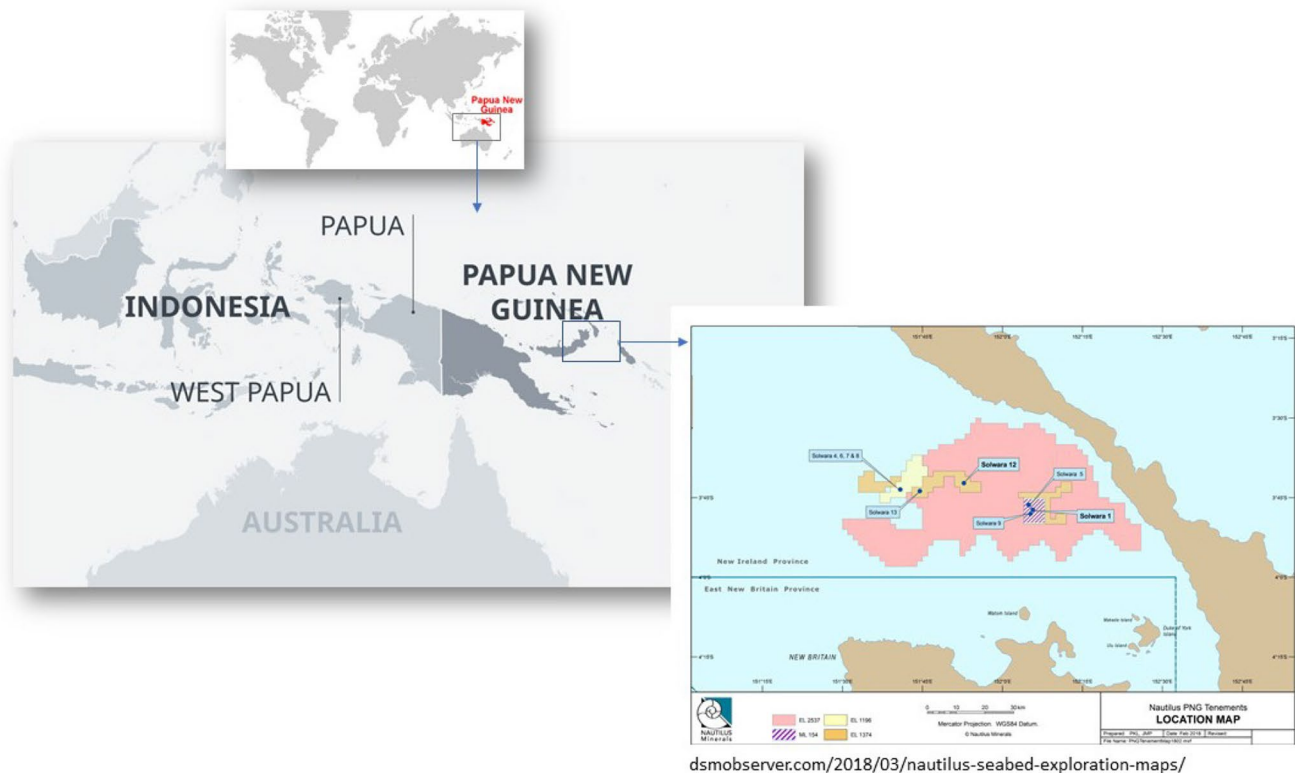


Fig. 2 Map with case study location of Solwara 1 project in Papua New Guinea

the international legal context, DSM activities must be sponsored by a state or national authority that exercises effective control (Willaert 2020). However, national laws that define the conditions for a sponsorship certificate are diverse (Willaert 2020) and not politically neutral (Carver et al. 2020), complicating the adaptation of, and adherence to, the ISA DSM agreement (Ardito and Rovere 2022).

Over 1.4 million km² of international seabeds have been set aside for mineral exploration in the Pacific and Indian Oceans, and along the Mid-Atlantic Ridge (Miller et al. 2018). Since the writing of the agreement, 31 contracts with 22 companies (referred to as “contractors”) for the exploration of deep-sea mineral deposits have been issued (2018) by the ISA.⁵ Twenty-five licences are in the Pacific Ocean, eighteen of which are in the Clarion Clipperton Fracture Zone (CCFZ). Exploration contracts are for 15 years, in which time contractors also have to establish, among other things, environmental baselines (Bräger et al. 2020).

Companies that mine inside EEZs are spared ISA environmental regulations and the ISA fees (Pennington 2009) as each country sets its own rules regarding exploration within their EEZ.

Deep-sea mining case study: Papua New Guinea

DSM became prominent in PNG when potential for exploration beneath the Bismarck and Solomon seas (Fig. 2) was established in the 1990s (Filer and Gabriel 2018).

Foreign companies have mainly been responsible for investment and management of mining projects in PNG. The PNG government gained equity in some major projects, investing government money and therefore owning part of the project. The PNG government has issued several exploration licences to Nautilus Minerals Ltd (“Nautilus”) to test the feasibility of DSM. A mining licence for Solwara 1 was granted to Nautilus in 2011 with production at the time expected to start in 2018. The grades of the Solwara 1 deposits are 7.2% copper, which is a higher grade than on-land deposits. The Solwara 1 project in PNG is one of the first exploratory DSM projects within the EEZ. The major legal mandates related to deep-sea mining in Papua New Guinea are the Mining Act 1992, the Mining Safety Act 1977, the Mineral Resources Authority Act 2005, and the Environment Act 2000 (Pennington 2009). The DSM activities are closest to the communities in the province of New Ireland, which also contains many small islands. The capital Kavieng is the largest centre (with over 17,000 residents in 2009). Kavieng serves as the main trading port and attracts dive tourism to the natural areas and shipwrecks.

⁵ www.isa.org/jm/exploration-contracts accessed 17.1.2023

PNG is a constitutional monarchy (represented by a British Governor General) with a parliamentary democracy and has a population of over seven million. PNG is classified as a Low Human Development Country and appears in the poorest quarter of all countries. In 2018, PNG had a Human Development Index level of 153 of 189 and a 40% rate of people living below the poverty line. Subsistence farming and fishing account for the bulk of economic activity in coastal areas. These activities take place mostly on land and seas with customary tenure. Mining (on land) contributes over one-third of government tax revenue and revenue from mining has resulted in high government spending. But inequality has been increasing, often attributed to conflicts arising from economic development in customary land and sea estates (Tilot et al. 2021, Kung et al. 2021, Bainton and Skrzypek 2021). A level of government dysfunction has been described by Bainton and Macintyre (2021) as an “absence of accountability among elected members and public servants” (p.107) at the local and provincial government level.

Terrestrial mining in PNG has had environmental, social, and economic impact (Yamarak and Parton 2021), leading to conflict between local communities and mining companies in the past (and in some place like Bougainville led to a civil war). The Ok Tedi mine is a well-researched example (Gilberthorpe 2013). Although the impact of terrestrial mining is not the topic of this paper, it is worth noting that the externalities created by the mining industry (such as pollution and conflict) should be borne by the company. In addition, a “shared authority” (Bainton 2021, p.434) with the custodians of the natural resources over the mining activities should be sought (Bainton 2021). Displacement of communities is one of the impacts of mining by private companies in PNG. The impacts and relative success of relocation vary between villages, with conflict ensuing in some (Hemer 2016). PNG citizens on the peripheries of mining projects may not be able to capture resource rents and have been referred to as “unofficial stakeholders” (Jorgenson 2006, p.234) that have been disproportionately affected (Jorgensen 2006, Jorgensen 2021). Mining has created welcome employment to PNG citizens of the remote communities, but distributional inequality has resulted in some places (Bainton 2021). Moreover, when the mines close, there is a danger that the traditional way of life cannot be resumed. This past terrestrial experience provides a salient context and lesson for DSM.

Method

To understand the causal complexity that links societal acceptance to conflict, we undertook a narrative analysis (Franzosi 1998) of media articles that reported on DSM in PNG. The reason for choosing the media as a source for our research was firstly because only a few peer-reviewed

articles have been published on the topic of societal acceptance of the deep-sea mining industry and location (Papua New Guinea) we were interested in (but see Childs, 2019). In contrast, a substantial number of media articles around aspects of societal acceptance and DSM had been published thus providing a rich and untapped source of information that was available for analysis.

We focussed on the narrative content of the text of the media articles which we analysed and interpreted for themes (Riessman 2007) related to societal acceptance (see our “Theoretical approach”). A total of 259 English language news media articles were obtained from the LexisNexis⁶ database. LexisNexis is a well-known, widely used, and comprehensive news database and has been used in many peer-reviewed papers to compile news/media data (see for example Spijkers et al. 2019).

Our decision to use LexisNexis was based on the comprehensive set of media sources maintained in this database. Some media sources might otherwise not be easily available due to paywalls and other access restrictions. There are many alternative ways in which media articles (and social media) can be scraped from the internet using for example news aggregators. However, because the research team had previous experience harvesting media articles from LexisNexis, this process was used instead of the internet scraping approach.

The articles harvested from LexisNexis provided insight into the most up-to-date developments (2011–current) and provided descriptive information regarding past occurrences. The query submitted to the LexisNexis web-based platform (lexisnexis.com.au) extracted content on Papua New Guinea (Papua PRE/1 content: New PRE/1 content: Guinea) and deep-sea mining (content:deep PRE/1 content:sea PRE/1 content:mining) OR (content:deep-sea-mining) OR (content:deep-sea PRE/1 content:mining) from News Print articles. The dates for the media analysis focused mostly on media post 2010. The weblinks or references provided in the articles were followed up and investigated thus allowing some media from pre-2010 to be explored.

Some media articles were not used in our analysis because they were either duplication of content (i.e. the same as another article) or not relevant. For example, articles identified as not relevant included articles that were announcing commencement of operations, stating a date, or stock market reported value increase or decrease. Similarly, if the article was mainly about another topic (i.e. mining in Congo) and

⁶ LexisNexis is a corporation owned by RELX and sells data mining platforms and information through online portals. They sell a wide range of information from different sources including news media (online and print). On the LexisNexis website, they report that they have 24-h global news API platform news coverage in 90+ languages and 235+ countries and territories.

mentioned PNG only in passing, it was marked as not relevant. In our database query, we did not specifically search for “indigenous” but acknowledge that this is an important next step for research in this domain (Hunter et al. 2018).

The final dataset contained 194 data points, of which around three quarters contained usable information. The remaining quarter was deemed not useful as it was not directly related to societal acceptance. The media analysis was carried out using 162 articles (in English) from 82 different media sources with the largest number (23) from PACNEWS (see Appendix A). Most of the media articles were from US media sources (55), Britain (22), and PNG (12). The total number of media articles we analysed is similar to studies in other fields using the LexisNexis (Huey and Apollonio 2018) and other databases (Mattson et al. 2021).

The extracted media articles from the LexisNexis database were downloaded into an Excel file containing the article ID, meta data (like media source, date, and language), a weblink to the article, and the full article text.

The text for each article was analysed for mention of any of eight aspects of societal acceptance (stakeholder, community, public, political, government, regulatory, domestic market, and export market). Quotes from the articles were highlighted in the Excel file and allocated to one of the eight societal acceptance themes. Illustrative quotes were also entered in Table 1a in Appendix 1 to ensure clarity on how the eight aspects were characterised and categorised. We did not undertake a quantitative analysis of the frequency that the different aspects of societal acceptance occurred in the 162 articles, but instead our focus was on the aspects of societal acceptance as described in the media articles as this was most informative and robust using this dataset.

It is important to highlight that the way we scoped out our empirical material limits our findings and constrains our analysis. Firstly, we highlight that print media may not be “objective” in the same sense that the peer-reviewed literature might be (Hampton 2008) and this issue may be reflected in our observations and discussion. Our database search limitations with respect to the timeline may further constrain our analysis since we may be missing significant societal acceptance issues that occurred prior to 2010. Another significant shortcoming of our approach is that we were unable to analyse the local PNG media due to language limitations of the author team. We were limited to English language media only. This means we might not reflect the local PNG situation with the necessary accuracy.

The peer-reviewed literature and reports (grey literature) formed the basis for documenting significant moments or turning points (events) in the history of DSM in PNG. We define an event as an incident (or something of importance) that happens or takes place. Events going backwards in time were recorded on a timeline. In the description of the timeline, we appropriately reference our events. The events for

DSM in PNG were categorised into (i) local - pertaining to the local community and the proponent company and (ii) extra-local events - related to PNG, technology, and international regulations and developments. The timeline information gained from the peer-reviewed literature was checked for internal consistency with the information gained from the media analysis. For example, in 2008, the EIA was provided by Nautilus for the Solwara 1 project, which is confirmed in both the peer-reviewed literature and various media articles.

In the discussion, we combine information on the aspects of societal acceptance with events identified on our timeline. We draw learnings from this to stimulate debate on DSM more generally. We identify and record events that were frequently mentioned in the media analysis which could explain aspects of societal acceptance and that pointed to the potential for conflict (whether expressed or latent, in the present or potentially in the future). Even though we use several sources of information (media articles, peer-reviewed literature, and grey literature) for our research, we acknowledge that further triangulation would have strengthened our results.

Results

In this study a societal acceptance framework (Robinson et al. 2021) and a historical timeline of events were combined to find critical junctures and tipping points to explain the conflict relating to DSM in Papua New Guinea. The end point (the point from which events were traced backwards) is 2022. We first present the timeline of events for the Solwara 1 DSM project (summarised in Fig. 3) and then present the findings from our media analysis where we categorised events related to the eight aspects of societal acceptance (Table 1).

Historical timeline of events related to DSM in PNG

A series of extra-local and local events set the scene for the arising conflict situation in relation to the PNG DSM Solwara 1 project (pre-2010). The entities involved in the conflict, which we previously defined as active disagreement (Alexander 2020), are many and there is a complex conflict arena. Essentially, the base of the conflict lies between local communities (and community groups) (Aswani et al. 2017) and a foreign company (Environmental Justice Atlas 2020). An active coalition of communities called the Alliance of Solwara Warriors (Papua New Guinea Mine Watch 2020), based in New Ireland around the Bismarck and Solomon seas, is at the forefront of protests. This non-violent conflict manifests in the formation of protest groups (Filer and Gabriel 2018) and legal procedures (Australian Mining 2017); it also engages the PNG government, other Pacific states, and international NGOs (Deep Sea Mining Campaign 2012). The scale of the conflict is at the local and regional

Table 1 Eight aspects of societal acceptance for a deep-sea mining project (Solwara 1) in Papua New Guinea. Main themes that arose from the narrative review of the media articles. Key quotes from media articles for each of the societal acceptance aspects are detailed in Appendix 1

Civil society	Aspect of societal acceptance	Description of societal acceptance regarding the Solwara 1 deep-sea mining project in Papua New Guinea
Public acceptance	Acceptance of industry by the wider general public, at the State, National, or international scale.	There was a perception by the wider general public that DSM is an industry characterised by inequitable blue acceleration and a push for blue growth. There was a perception that DSM development could monopolise mineral resources and potentially lay claim to (currently publicly owned) territories—with wider implications. For people in the Pacific, there was a perceived lack of Free Prior and Informed Consent (FPIC) for this type of mining. FPIC should recognise indigenous people's inherent and prior rights to lands and resources. It should respect indigenous people's legitimate authority and third parties must form an equal and respectful relationship with them based on the principle of informed consent [Procedurally, free, prior, and informed consent requires processes that allow and support meaningful choices by indigenous peoples about their development path"] Un Sub-Commission on the Promotion and Protection of Human Rights (2004) Report of the Working Group on Indigenous Populations on its twenty-second session. UN Sub-Commission on the Promotion and Protection of Human Rights Geneva. p. 5, quoted in Hanna, P. & Vancly, F. (2013) Human rights, Indigenous peoples and the concept of Free, Prior and Informed Consent. Impact Assessment and Project Appraisal 31:2, 146-157.]
Community acceptance	Acceptance of industry by members of the <i>local community</i> , in particular residents living in proximity to the area in which the sector operates.	Although it is important to note that support for the DSM activities and the perceived economic benefits to PNG were also evident, many concerns were raised around DSM by local communities centred around local environmental, social, economic, and cultural impacts. Disruption of culture (particularly customary rights to land and sea territories) was perceived to go hand in hand with environmental disturbance. Health implications were also highlighted with the potential for toxicity to enter the food chain which was perceived to be detrimental for both humans and animals. The local community have sought to fight the DSM project using legal avenues. The perception that the benefits of the DSM activities will not flow to the local community but instead to the rich countries and the large mining companies, was seen to exacerbate existing distributional inequities. People in the local communities did not perceive they had given FPIC (see also public acceptance) and criticised the company's consultation approach even though the company indicated that they had undertaken exhaustive consultation.
Stakeholder acceptance	Distinct public and community acceptance that more clearly differentiates the relevant groups and level of acceptance	The most prominent stakeholder in relation to DSM was the conservation sector and biodiversity more generally. The potential for environmental impact and the lack of information about the deep sea was seen as a significant risk. The fishery industry was expressly concerned about the economic impact of DSM on their sector. Concern was also expressed in statements by indigenous people/groups—particularly around the potential for disenfranchisement of this group and power imbalances being aggravated accordingly.

Table 1 (continued)

Aspect of societal acceptance		Description of societal acceptance regarding the Solwara 1 deep-sea mining project in Papua New Guinea
The governance system	Political licence Approval by the wider public of government and associated regulatory processes, where political decision-making on DSM is aligned with broader social interests	Concerns were expressed around the realities of governance in PNG. The PNG government was perceived as corruptible in relation to the investment decision around DSM. A concern that went beyond PNG to the broader Pacific was around perceived unequal bargaining power and in particular access to the legal system—which was perceived to favour large industry. Previous experience of the lack of protection of indigenous communities from large industry (and their environmental and social impacts) served to strengthen this argument.
	Government licence Approval of, and support for, industry by government based on their current policies and agendas	The government invested in the DSM project but subsequently lost money on the investment when the company folded. Even though there was support for this investment, there was a perceived lack of policy or adequate legal framework to make such an investment.
	Regulatory licence Approval of industry operations stipulated by meeting specified (and measurable) requirements set out in regulations or rules of conduct, often related to managing the industry	International organisations expressed concern around the ability of the PNG government and the regulatory framework to deal with DSM issues. The lack of an adequate regulatory framework will potentially mean fast and unbounded development of DSM in the area. Because the ISA regulations (for high seas activities) may have been perceived as restrictive this could have encouraged companies and investors to seek areas within EEZs. However, the lack of capacity for implementation of a deficient regulatory framework is a focus of concern.
	Domestic market acceptance* Acceptance of DSM mining and products by domestic consumers, retailers or investors (e.g. here loans/stock market investment in DSM companies).	Significant initial capital raising and financial investment supported the DSM company. The domestic market thus strengthened this emerging industry (even though no DSM product is, as yet, for sale). There was a perceived need for a demonstrably successful enterprise in the DSM industry to highlight its potential and further development. The company lost acceptance when they were unable to meet their financial commitments, and allegations of fraud arose which may ultimately have contributed to their downfall.
Export market acceptance** Acceptance of industry products by international consumers and investors (here DSM minerals are input for products)		There was support for DSM due to the contribution of these minerals to the green technology and renewable energy sector (decarbonisation). There was much focus and enthusiasm for the development of this sector and opportunities were seemingly boundless. At the same time there were concerns over the large companies involved and the potential for monopolisation of the resource by major political powers. There are moves by large industry to ban the use of DSM product in their supply chain.

*Because DSM products are not (yet) available even though similar minerals are being mined on land, domestic market acceptance was interpreted in terms of the loans made available to DSM companies and the relative attractiveness of DSM investment

**Export market acceptance was also interpreted by proxy in terms of the industries that the DSM minerals would be used for. These products are currently marketed as key to green technology development and decarbonisation

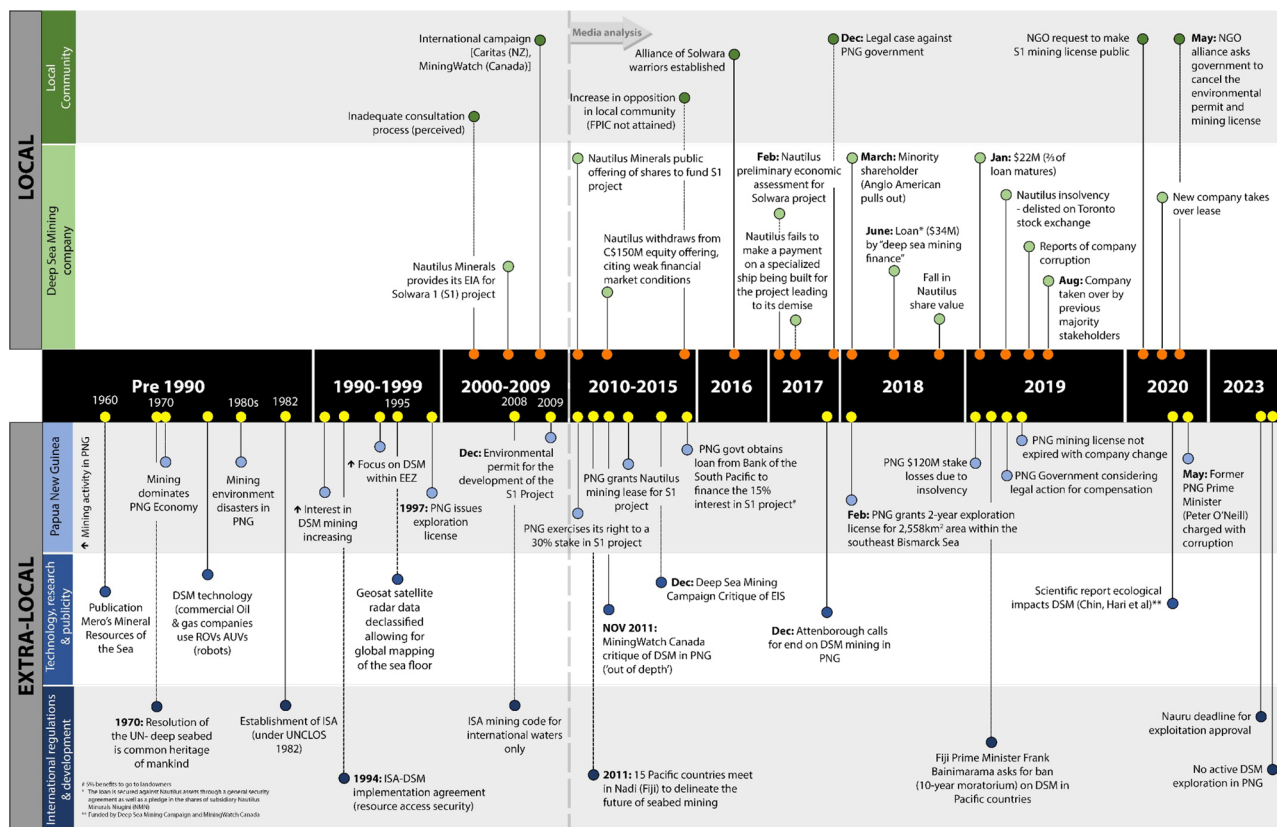


Fig. 3 Timeline with local (above the black line) and extra-local events (below the black line) leading up to the present, of Solwara 1 project in Papua New Guinea. The timeline only lists main events and

is potentially incomplete. The vertical dashed line denotes the date from which the media analysis (see “[Method](#)”) was undertaken

scale, but the many extra-local entities that are actively engaged (such as international NGOs) extend the conflict to the national and international level (Environmental Justice Atlas 2020). The timeline of events helps us to understand this complex situation in more detail. We first discuss what enabled the Solwara 1 project to go ahead in PNG.

Prior to 2000, there are several extra-local events that enabled the Solwara 1 project to be established, and that can be summarised as (1) availability of mapped resource areas, (2) available technology, (3) economic viability, (4) global (China driven) demand for metals, (5) international regulations, (6) security of resource access, (7) a history of mining activities, and (8) poverty alleviation and national autonomy.

From the early beginnings of DSM in the 1960s, an increasing amount of relevant spatial data became available for the deep sea (Lodge and Bourrel-McKinnon 2022), and the technology for exploration became cheaper, thus making DSM more economically attractive (Roche and Feenan 2013). Population growth and strong global demand for metals (driven largely by China) created a favourable economic situation for exploration (Roche and Feenan 2013). The ISA DSM implementation agreement put in place in 1994 helped spark the

search for DSM areas by international companies (even though the Solwara 1 project was located within the PNG EEZ and thus not within the realm of the ISA regulations) (Rosenbaum and Grey undated). The need to secure resource access and a stable industry supply underpinned the drive to put agreements in place inside and outside EEZs (with national governments) (Roche and Feenan 2013). A favourable precondition for DSM in PNG was the fact that mining on land was already a key economic sector in this country and the source of high government revenue. This may have contributed to the country's readiness to licence DSM. Roche and Feenan (2013) list several other primary drivers of this openness, such as an alternative opportunity to alleviate poverty in line with rising aspirations and secondary drivers such as “national independence and autonomy” (p.27) (also mentioned in Filer and Macintyre 2006).

At the same time, communities in PNG had been exposed to and experienced the environmental and social impacts of terrestrial mining (Murray et al. 2000, Roche and Feenan 2013, Filer and Macintyre 2006). In the context of controversial environmental standards, mine waste was discharged to PNG rivers and oceans on a large scale leading to displacement and significant social impacts (Mudd et al. 2020).

Between 2000 and 2015, many parallel local and extra-local events shaped the DSM sector in PNG. Pacific countries came together to discuss the potential of DSM but also the future risk the activity could pose (Reuters 2022). This happened while international NGOs became increasingly concerned about the ecological and socio-economic risks of DSM (United Nations Environment Programme Finance Initiative 2022). Concerns about the risk of DSM resulted in a series of media campaigns, for example the campaign “deep sea mining is no answer to the climate crisis” (Childs 2022, p.5) at the COP26 People’s Summit for Climate Justice (Childs 2022). Meanwhile, Nautilus (the company operating in PNG) was listed on the stock exchange (in Canada) and an Environmental Impact Assessment (EIA) for their planned PNG operations was produced (Clark et al. 2020). The Environmental Impact Statement (EIS)⁷ was however criticised by international NGOs and community groups (Filer and Gabriel 2018). Specifically, the EIS was perceived to lack details on the multiple environmental, social, and economic risks (Rosenbaum and Grey undated). While concerns over DSM risks increased, the PNG government nevertheless granted the environmental permit and mining lease to the company in 2011 and invested government funds in the project (The Guardian 2012). Filer et al. (2021) assert that granting this exploration licence led to a debate “... about the formulation of a national offshore mining policy that had not been concluded by the time the mining licence was issued” (p.103).

Local opposition to the project continued to increase after 2015 (Filer et al. 2021). The involvement and opposition of prominent public figures (i.e. David Attenborough) and NGOs to DSM further supported the concerns and actions of local groups (Childs 2022). Scientific reports on the ecological impacts of DSM (Fauna & Flora International 2020) provide ongoing additional support to local opposition (United Nations Environment Programme Finance Initiative 2022). Leading figures in the Pacific community (e.g. the Fiji Prime Minister) have called for a moratorium on DSM (Reuters 2022). The local community, basing their claims on local environmental concerns and their basic ancestral rights to land and sea tenure, in tandem with NGOs, raised alarms that resulted in the opening of a legal case in 2017 (Australasian Mining 2017, Filer et al. 2021).

At the same time, the company was faced with solvency problems (Deep Sea Mining Campaign 2019, The Guardian 2019). This culminated in a minority shareholder withdrawing their support for the company; the situation was possibly exacerbated by transparency issues that arose with respect to Nautilus’ company structure and its approach to governance and consequent loss of

corporate responsibility (Filer et al. 2021). The company entered insolvency in 2019 thus ending the Solwara 1 project. The people of PNG, through their government’s investment in the project, have lost hundreds of millions of Kina (around \$120 Million USD) invested in the project.

Summarising the timeline of events (based on a review of the English language literature) surrounding the failure of the Solwara 1 DSM in PNG, we can say that prior to 2000, a combination of extra-local events guided the enthusiastic entry by PNG into a DSM venture with the Canadian company Nautilus. After 2000, local events drove opposition and the eventual ending of the Solwara 1 project. The decline started after the publication and subsequent criticism of the EIS, which accelerated the already growing local and NGO opposition. The establishment of an alliance, and a legal case upped the pressure, but eventually all came to a head with financial and credibility issues around the company leading to its decline.

Media analysis

As a general trend, the focus of the media articles mirrors the events as described on the timeline (Fig. 3). The early articles highlight the technical and scientific discovery and the economic potential of an “exciting” new industry (some written by the company, or mining consultants and published mainly in the financial and mining media). Over time, the media increasingly focussed on the environmental risks and the socio-cultural implications of DSM activities. Many of these articles draw on scientific reports published by NGOs (e.g. Chin and Hari 2020) culminating in a report by the UN (United Nations Environment Programme Finance Initiative 2022).

Around 2015 and thereafter, the focus of many articles was on the financial troubles of the company (Nautilus), especially when their financial problems became public, and again when a minority stakeholder withdrew support (see Table 1 for quotations). Perhaps unsurprisingly, the media sources for the company-related information tend to have a mining (e.g. Mining Engineering) and finance (i.e. IHS Global Insight) focus. The articles in the years around 2020 focus on the local opposition to the mine and the call for a moratorium by Pacific nations. The failure of the company is again the focus of many of the financial and mining media sources.

The contents of the media articles were assessed for the different aspects of societal acceptance of the Solwara 1 DSM in PNG. We find reference to all eight aspects of societal acceptance in the media articles (most indicating a lack of acceptance). Table 1 summarises how of each of the eight aspects of societal acceptance applied to Solwara 1 DSM in PNG (further discussed in the text). We support our descriptions with relevant quotes from the media analysis and the media source ID in Appendix 1.

⁷ An EIS reports on the results of an EIA process. The EIA is a process through which the development impacts are outlined.

Negative media messaging of the governance system was particularly focussed on the perceived lack of *regulatory licence* for DSM Solwara 1 project in PNG. The media sources highlighting regulatory licence issues were many—and included the Guardian, the Australian ABC, and the Observer as well as local PNG sources. Importantly, there were questions around the abilities and capacities of the PNG government to deal with DSM and the inadequacies of the regulatory framework. Reporters perceived a risk of overexploitation of marine environments, which could threaten the environmental and socio-economic resilience of local communities and ecologies. The observations of the lack of regulatory licence coincided with negative messaging on the lack of *government licence* as investment money was lost to the failed company and project. Much of this is reported in the Pacific Island New Association (PACNEWS) and the Pacific Island Broadcasting corporation. The lack of government licence was explained by the historical lack of *political licence* due to an ineffective and reputedly corrupt⁸ government (Bainton and Macintyre 2021) and with low bargaining power where large mining companies are acting like proxy States to support their own economic and financial aims (Bainton and Macintyre 2021).

Media articles that focused on the local communities mostly highlighted a lack of *community acceptance* of the DSM project (reported extensively in PACNEWS and the main international media sources but to a much lesser extent in the PNG post courier). Around 2000, there were mixed positive reports regarding the benefits of DSM to the community and to PNG—but this messaging later became mostly negative. This was explicit in the perception of inequitable blue growth and the potential for outside actors to lay claim to territories that are recognised (to a certain extent) as customary by the PNG constitution (as reported for instance by The Independent but also Basic Materials and Resources Monitor Worldwide). Pacific nations and the local community were perceived not to have given free prior and informed consent (FPIC) which reduced both *public acceptance* and *community acceptance* (Uffman-Kirsch et al. 2020). The company consultation process (as part of the EIS), that should have provided the prior information, was perceived as inadequate (see also Environmental Justice Atlas 2020). The nature conservation lobby and fisheries were highlighted as the key groups for the lack of *stakeholder acceptance*. The lack of public and community acceptance was refuted in articles written by the company where the consultants indicated their experience in PNG

doing workshops and meetings across the country. The focus of Nautilus was on communities nearest to the Solwara 1 Project (i.e. the coastal villages along the west coast of New Ireland Province and the north coast of East New Britain Province, as well as the islands) but also meeting with communities over 600 km away at their request. The PNG Post Courier also highlighted the company's social and business investments in the community.

With respect to societal acceptance by markets, a change in market acceptance can be observed over time. At the start of the venture (around 2010), PNG media sources, as well as the financial and mining media, highlighted their support for the emerging DSM industry and the minerals to be produced. The capital that was raised and investment into the industry are evidence for this market acceptance. *Domestic market acceptance* was negatively impacted when the company was unable to attract capital for the project and could not meet their financial obligations with allegations of fraud (reported in the standard media such as the Observer but sources News Bites Canadian Markets). As mentioned earlier, the narrative around the company was initially predominantly positive particularly highlighting the economic potential. After the company failed, some of the assets of Nautilus in other Pacific nations were acquired by a new company but there is no explicit evidence of renewed activity by the company in PNG which would likely have attracted negative media coverage.

Early positive media messages were also reflected in *export market acceptance* where the enthusiasm for the development of DSM and the opportunities for decarbonisation and green technology were the focus of the messages. This enthusiasm was tempered by concerns over monopolies and the perceived geopolitical imbalances in business power and resulting inequities. In one article in the Honolulu Star-Advertiser, it was referred to as the last re-division of the world. These concerns contributed to the subsequent bans for use of DSM products in some industries. Nevertheless, the perceived need for DSM minerals as the basis for green technology and decarbonisation is an argument frequently presented as in favour of industry development.

As outlined in our “Introduction”, the usual treatment of societal acceptance only accounts for community approval. To comprehensively understand the social and ecological context of DSM, it would be useful to assess the antecedent events and developments that lead to conflict-related events around the Solwara1 project in PNG. From our media analysis, we observe that the combined effect of a lack of stakeholder, community and public acceptance, the perceived inadequacy of the regulatory system around DSM (lack of regulatory licence), and the loss of market acceptance for the company Nautilus is mutually reinforcing and increasing the likelihood of conflicts breaking out. Lessons can be drawn from the influence of both local and extra-local causal

⁸ PNG ranks 124 out of 180 countries on the corruption perceptions index <https://www.transparency.org/en/countries/papua-new-guinea> and other indices like <https://tradingeconomics.com/country-list/corruption-index>.

and contingent events on social acceptance in PNG for other cases and countries where the potential for DSM exploration exists.

Discussion

Population growth and a transition to low-carbon economies (Dreyer and Walker 2013) are testing global supply constraints for minerals (Amon et al. 2022). Some argue that the development of DSM may be inevitable if we are to meet increasing demand for minerals (Roche and Feenan 2013), while others present recycling as a viable alternative to DSM. When new industry develops—particularly when it requires high levels of technology and investment—gaining societal acceptance (Moffat et al. 2016) can add costs to what is already an expensive development process (van Putten et al. 2021). This can provide an impetus for industry to avoid these costs associated, for example, with the amount of (valuable) time needed to gain community trust in their operations and governance structure. But the risk of not gaining or losing societal acceptance can derail a project at any stage (Harvey and Bice 2014, Edwards et al. 2019). There are multiple risks—financial and operational—that businesses and governments must balance and navigate, and gaining and retaining societal acceptance is one of them.

Gaining societal acceptance is also important when considering the potential for conflict (Parsons et al. 2014). The conflict potential can be reduced if good governance principles (Lockwood et al. 2010) are adhered to with respect to gaining societal acceptance (van Putten et al. 2018) and customary land and sea tenure systems are respected (Aswani et al. 2017). This is a positive result if the industry is really operating under best practices and providing benefits while minimising, or preferably avoiding, undesirable outcomes (Tuokuu et al. 2019).

With the expansion of economic activity in our marine environment and increasing pressures on our oceans (IPCC 2019), conflicts around marine resources have the potential to increase (Spijkers and Boonstra 2017, Spijkers 2019, Spijkers et al. 2019). Using a narrative analysis (Franzosi 1998) of media articles and constructing a timeline of events (using peer reviewed and grey literature), this study identifies how the different aspects of failing to gain societal acceptance may be preconditions for a conflictive outcome. We find that eight aspects of societal acceptance related to civil society, the governance system (both local and national), and the market contribute to a conflict outcome—and show with our study on a PNG case, that they can occur at different times during industry development.

The timeline of events that led to the eventual demise of the Solwara 1 DSM project in PNG started with a sequence of supportive (seemingly positive) extra-local events that

enabled a Canadian company (Nautilus) to gain a deep-sea mining lease in PNG. The initial period up to around 2000 was characterised by market acceptance and legitimisation of DSM exploitation accompanied by a dominant narrative that highlights the economic benefits and technological innovation. This market acceptance was partly driven by (global) population growth and a growing need for mineral resources in conjunction with decarbonisation (Childs 2019). The narrative around the inevitable necessity and economic opportunity posed by DSM dominated the media coverage of the Solwara 1 DSM project in PNG (Filer et al. 2021) in this early period.

Over time, the market narrative was counterbalanced with a focus on the potential for the market to be unjust and unfair (United Nations Environment Programme Finance Initiative 2022, Lodge and Bourrel-McKinnon 2022). The narrative pivoted to one that increasingly focused on monopolisation of mining resources (including DSM minerals) by single nations driven by a need for resource security (Zhang 2018). There was also an increasing focus on the intensifying race to licence areas of the deep ocean for mining (Ibrahim et al. 2022), also referred to as ocean grabbing (Bennett et al. 2015). The economic argument occurs alongside, and clashes with, a debate on the large and unclear potential for environmental risks posed by DSM. Many deep-sea species and ecosystems are yet undiscovered or poorly known (Fauna & Flora International 2020). The potential for unresolved environmental risks has prompted countries to ban DSM in their waters (e.g. the actions by Prime minister Frank Bainimarama in Fiji), companies to call for pause on DSM⁹, and institutions such as the European parliament to call for a moratorium¹⁰.

Even though market acceptance was only one of the three components of societal acceptance that contributed to the demise of the Solwara 1 project, the Pacific and global debate around DSM (and that in other Pacific nations with DSM initiatives) will likely continue to pivot between a positive and negative narrative. The positive will likely focus on the growing need for access to resources for decarbonisation (Roche and Feenan 2013) and the negative will likely be around the social inequities associated with privatisation and ocean grabbing (Bennett et al. 2015) and the potential for large and mostly unknown socio-ecological risks.

In the context of growth-oriented strategies, a lack of market acceptance may cause conflict. In PNG, a steady fall in public, community, and stakeholder acceptance of DSM

⁹ <https://www.reuters.com/business/sustainable-business/google-bmw-volvo-samsung-sdi-sign-up-wwf-call-temporary-ban-deep-sea-mining-2021-03-31/> accessed on 17.01.2023

¹⁰ <https://www.reuters.com/business/environment/eu-should-promote-moratorium-deep-sea-mining-lawmakers-say-2021-06-09/> accessed on 17.01.2023

in PNG occurred in parallel with a decreasing domestic market acceptance of the company—as it failed to meet financial obligations and accusations of fraud emerged.

In our PNG case study, the acceptance of DSM by the public, communities, and stakeholders was decreasing in line with the increasingly perceived environmental risks and growing concerns about local economic and socio-cultural impacts. The cultural and environmental concerns are highlighted by Childs (2022) who points to the importance of understanding and recognising the seabed as a collection of “living worlds”. The lack of societal acceptance of the Solwara 1 DSM project in PNG comprises of, for example, the economic impacts on fishing which decreased stakeholder acceptance. Also critical to a lack of community acceptance was the perception that traditional uses of marine environment (that tend to occur at the local level) were ignored by the company and government actors. This lack of acceptance likely influenced DSM development and has contributed to the demise of the Solwara 1 project and potentially of future DSM operations in PNG. Finding new ways to allow community voices to be heard and share equitably in the benefits is necessary for emerging industries like DSM (Norström et al. 2020, Cvitanovic et al. 2015, Karcher et al. 2021).

The second dimension of societal acceptance is the governance system, where an absence of political and regulatory approval can derail a project. The legitimacy, inclusiveness, equity implications, and transparency of the formulation and implementation of regulatory institutions provide the broader community with confidence that key concerns are anticipated and addressed (van Putten et al. 2018). For example, having a clear and rigorous approach to monitoring, and open access to such data, helps to address concerns about environmental effects. Early in the development of the Solwara 1 project, the absence of political and regulatory approval constrained the outcome to one of conflict (Moffat et al. 2016, Moffat and Zhang 2014). The mining companies acting like proxy States to support their own objectives (Bainton and Macintyre 2021), resulting in a lack of government bargaining power, may be partly to blame. The loss of government investment also indicates that strong asymmetries in the abilities and capacities of the PNG government and the involved companies to deal with DSM and may highlight shortfalls in the regulatory framework. Cues for regulations within EEZ could be taken from international developments and the ISA. There are processes in place that aim to develop a more carefully considered approach to assessing the desirability and the boundaries to the new DSM industry development under debate.

The Solwara 1 project has failed, and the combined lack of acceptance by civil society, the governance system, and the market (the three dimensions of societal acceptance) has weakened or even stopped the trajectory of the DSM

industry development in PNG. We do not attribute the failure of the Solwara 1 project to any one particular aspect of societal acceptance but have shown here that the lack of overall acceptance worked together to create this particular situation in PNG. However, this timeline of events for PNG may not have diminished the industry’s prospect in other parts of the Pacific island region. There may be contextual differences between PNG and these other Pacific nations that influence the aspects of societal acceptance. It cannot be said with any certainty, but the legitimacy, inclusiveness, and transparency of the governance system, balanced bargaining powers, and more corporate responsibility, as well as the persuasive narrative around green energy, may create a different operating space in other nations. Our study shows that through investigating aspects of societal acceptance in combination with identifying a timeline of events can give important insights for other Pacific nations engaged with DSM.

While our approach provides novel insights into ocean-related conflicts and the underlying events that shape conflict, our narrative review of media articles is restricted in the time it covers and by the depth of the analysis usually found in the media, and potential biases reflected in the print media. However, by unpacking the complexities of a multi-component framework of societal acceptance, we hope to contribute to future debates around managing conflict around DSM also beyond EEZs in the realm of our public good—the high seas.

Acknowledgements We thank the multiple reviewers for their input, comments, and suggested changes. The multiple rounds no doubt improved the paper. We would like to especially thank J. Spijkers for her help with accessing the media data.

Author contributions Conceptualisation, material preparation, data collection and analysis were performed by Ingrid van Putten. The first draft of the manuscript was written by Ingrid van Putten and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions This research was undertaken as a deliverable for the NOCRISES project (Negotiating Ocean Conflicts among Rivals for Sustainable and Equitable Solutions) funded by Belmont Forum. The paper was first conceived at the annual meeting of the NOCRISES team in Bremen.

Declarations

Ethics approval N/A.

Consent to participate N/A.

Consent for publication All authors give consent to publish.

Conflict of interest The authors declare no competing interests.

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