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Volumetric, embodied and geologic geopolitics of the seabed: offshore tin mining in Indonesia

Merdeka Agus Saputra  ^{a,b,c} and Katherine G. Sammler  ^d

ABSTRACT

This paper introduces empirical research on tin divers' bodily experience of seabed mining concerning offshore Bangka and Belitung Islands, Indonesia, critical seabed mining sites. To govern the seabed off these Islands, 'classic' geopolitical approaches such as marine spatial planning (MSP) and the Organisation for Economic Co-operation and Development (OECD) hierarchically construct the seabed through two-dimensional mapping and policy, occluding specific tin diving practices on the seabed. Moving from such flat geopolitical understandings of the ocean floor, this paper offers new engagements with feminist geopolitics, volumetric territory and social ocean studies to think about the seabed through its volume, the bodies that are immersed within and animate it, and its geologic materiality. It does so by examining intimate tin diving relations between human bodies, volumetric space and ore bodies in relation to the contemporary geopolitical making of the seabed territory. Whilst many scholars have engaged with this volumetric-embodied-geologic approach, this paper argues that the nexus of volumetric space, bodies (embodied experiences) and geologic materiality in tin diving are a crucial tactical point for diverse mining governance actors, sustaining dangerous labour, mining accidents and death in tin diving.


KEYWORDS

Access; tactical point; materiality; political ecology; territories; feminist geopolitics

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1. INTRODUCTION

Amid blue growth narratives touting the ocean as a solution to many economic and resource woes on land, the seabed has been framed as a place undergoing a 'new gold rush' that attracts extractive industries to exploit commercially valuable seabed minerals (Grabski, 2019). However, long before this narrative of capitalist expansion, commercial large-scale seabed tin mining and artisanal tin diving off the Bangka and Belitung Islands have extracted the seabed for over 150 years (Irzon, 2021). Tin diving, locally called *TI selam* (*penambangan timah inkonvensional selam*),

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began with colonisation by the Dutch and British East Indies that subdued the Sriwijaya Kingdom in 1880 (Dunia Tambang, 2020). With many people working in tin diving under the colonial tin trade and extraction controls, tin diving has supplied tin ores worldwide since Dutch and British colonialism (Prianto & Husnah, 2017; Nugraha & Purwanto, 2020). The colonial powers of the Dutch and British East Indies accumulated tin ores primarily because of their mouldable and anti-corrosive characteristics that were used for making the canned food and weapon industries, enabling the imperial Dutch and British East Indies to expand their conquest and slavery system (Erman, 2017).

While the Dutch and British slavery systems existed in the past to force enslaved people to collect tin ores from the seabed, the social and material hierarchy of colonial, enslaved and ore bodies in this system has been maintained through time in seabed tin mining by current geopolitical governance regimes. For instance, during the Dutch and British colonial tin extraction and trade controls, the social strata of the Chinese people were deemed higher than that of the Native Malay, demonstrated by how Chinese people were selected to work on the boat, charged with identifying tin ores from the seabed sediments the Native Malay brought to the surface as divers (Ibrahim et al., 2018). The relative danger and the physical position of their tasks here indicate how the strata of the bodies of these enslaved peoples were of lower value to Dutch and British overseers than even the tin ores they collected. Meanwhile, at present, international tin buyers, domestic tin collectors, mining companies and provincial and central governments benefit from purchasing the ores tin divers collect, maintaining the notion that tin ores are more valuable than the health and safety of tin divers (WALHI, Wahana Lingkungan Hidup, Interviews on 5 June 2022). This tin supply chain can exist as the OECD (the Organization of Economic Collaboration and Development) and MSP (Marine Spatial Planning) policies only focus on governing the large-scale seabed mining through their mining standards (e.g., personal protective equipment (PPE) use, mining permits and environmental impact assessment) (Syari & Nugraha, 2022; Readhead et al., 2023). Therefore, as both Marston (2020) and Dixon (2019) argue, the stratification of miners manifests as the vertical and material arrangement of bodies; in the case of tin diving, this hierarchy applies to not only the bodies of the Dutch, British, Native Malay, Chinese peoples, and current tin buyers but also how the geologic ore is figured in the arrangement.

Even though current works have enabled us to understand the role of geopolitical governance in maintaining the social strata of colonial, enslaved, and geologic materiality in seabed tin mining (Wargadalem, 2023), the geopolitical narratives and discourses here have solely told a story of the geopolitical governance of seabed tin mining. That is because it orientates us on the geopolitical capability of hierarchical approaches such as the Dutch and British East Indies and the current governance of seabed tin mining to control and exploit bodies of divers, tin ores and the seabed (Ranto et al., 2023). This geopolitical orientation flattens the seabed by rendering bodies, geologic materiality and the seabed as a mere backdrop of such top-down governance, excluding how bodies, tin ores and the seabed also co-shape the current geopolitical governance and actual practices of seabed tin mining. This argument aligns with the work of Childs (2020) on how the geopolitics of the seabed often sees the seabed as a passive and ready-to-exploit object. Therefore, to provide an alternative understanding of the geopolitical governance of seabed tin mining, it requires an understanding of the complexity of seabed tin mining by considering how tin divers' bodies, tin ores and the seabed interact with the current top-down geopolitical intervention to sustain dangerous labour practices, diving accidents and even death in this industry. This means that not only does the hierarchical top-down governance use tin ores, the seabed and tin divers to benefit from tin production, revenues and tax payment, but tin divers also utilise these factors to continue exploiting tin ores, resisting or assisting the hierarchical top-down governance (Figure 1).

This paper argues that the nexus of human bodies, tin ores and the volumetric space of the seabed has become a crucial tactical point (Barry & Gambino, 2020) for many actors in exploiting the seabed. That is because the provincial government, OECD, mining corporations, tin divers

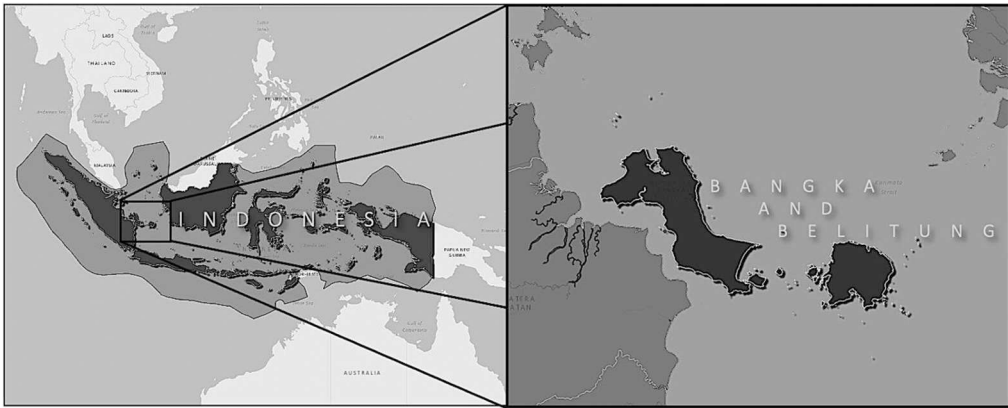


Figure 1. Bangka and Belitung Islands, Indonesia.

Source: Map by authors using data from Esri, Garmin, USGS, and UC Berkeley.

and other mining actors use the volumetric-bodily-geologic materiality of the seabed to access tin ores and obscure certain activities from public scrutiny. To underpin this argument, this paper approaches this research by considering the intertwined materiality of volumes, bodies, and geologies that converge through the practice of tin diving. This paper demonstrates not only how geopolitics in seabed tin mining permeates global, volumetric, bodily and even geologic scales but also how the material and vertical arrangement of the physical space (the sea's surface, the water column and the seabed) interacts with the hierarchical arrangement of human and ore bodies politically constructed by global mining trades, mining companies and their industrial equipment. This insight is crucial and urgent as this analysis flips public scrutiny from focusing on the effectiveness of the classic geopolitical interventions toward the body, volumetric and geologic materiality of the seabed, which becomes a material foundation of power in geopolitics (Peters et al., 2018) and a tactical point for collecting revenues from the invisible and hard-to-access seabed. The material foundation of power politics here refers to how the volumetric-bodily-geologic materiality relations in tin diving have been crucial for the manufacture of electronic devices and weapon industries and the geopolitical governance to continue running and intervening in seabed utilisation and the production of the seabed territory.

This paper is divided into four sections. The first section explains qualitative research methods used in the fieldwork to collect empirical findings about tin diving. Understanding the relation between the tin divers, tin ores and the volumetric space of the seabed in this practice through the fieldwork, the following section reviews diverse scholarships of the new materialist geopolitics, focusing on current works the volumetric-bodily-geologic approach to inform our concept on how bodies, geologic materiality and volumetric space have become a tactical point in the seabed tin mining operations. With the utilisation of this approach, the subsequent section provides the critical dialogue and analysis between empirics and concepts to deeply analyse why and how the volumetric-bodily-geologic relation in tin diving matters for geopolitical considerations. Finally, the last section concludes the discussion by emphasising how this tripartite is crucial in geopolitical governance as it defines the (in)effectiveness of the OECD and MSP intervention in governing the seabed and the seabed tin mining.

2. RESEARCH METHODS

This paper relies on qualitative methods comprising ethnographic fieldwork on and offshore of Bangka and Belitung Islands, Indonesia. The period of fieldwork occurred over four months in

the spring and summer of 2022. The first author is a native Indonesian speaker and completed all in-country data collection, utilising in-depth interviews, participant observations, focus group discussions (FGD) and a research diary. During participant observations, a waterproof GoPro camera was attached to a tin diver's body to capture how they engaged with the seabed pits to recover tin ores. Such mobile video ethnography (MVE) is crucial, primarily when accessing a social practice in an unsafe and difficult space (Spinney, 2015; Squire, 2017) like the seabed pit. The MVE also enabled the researchers to capture experiences that might not be explained thoroughly during the interviews, such as how tin divers descend and what tools they use to explore the seabed pits. In general, this array of qualitative methods enables the researcher to talk and think with interlocutors about tin diving operations.

The interlocutors in this research project varied from tin divers, former tin divers, mining corporation representatives, geologists, sociologists, ecologists, governmental employees and non-governmental employees ($n = 20$). Empirical data on local tin mining history was gathered from the Tin Museum, and provincial regulation review regarding seabed tin mining operations was collected from PERDA (2020). The first author also joined Padi diving courses to understand diving risks and safety protocol as a reflection for tin diving operations. The second author also has previous dive training. While scuba and tin diving are different, they engage with the undersea conditions, which is crucial to grasping the anxiety and vulnerability of the tin divers' embodied experiences.

In this research project, interlocutors gave informed consent by signing the letter of consent and giving verbal consent. Before conducting the interview, the first author explained the purpose of the research, asked whether they agreed to the interview, and handed the consent letter to academics, governmental employees, mining corporation representatives and non-profit organisations. The letter covered the agreement to use the information for the research publication and the change of participants' names to pseudonyms for personal interlocutors' data protection. For tin divers, they gave their informed consent, which was verbally recorded by a recording device. That is because they are mostly illiterate, and signing a written informed consent agreement may present concerns for their mining operations. The positionality of the first and second authors working in Germany and the Netherlands is acknowledged. The authors obtained financial research support from European academic institutions to conduct in-country fieldwork and analysis as part of a system benefiting from previous and ongoing colonial relations. Such reflexivity was essential to shaping data collection and analysis towards a careful focus on tin divers' entanglement within broader geopolitical configurations.

3. VOLUMETRIC, BODILY AND GEOLOGIC MATERIALITY AS TACTICAL POINTS IN GEOPOLITICS

In the new materialist interpretation of geopolitics, many feminist, post-structuralist and decolonial scholars have focused on analysing the convergence of material and political agency by considering humans, non-humans, spatiality, temporality and materiality of a physical space (Barry, 2013; Child, 2020; Dixon, 2016; Dodds, 2019; Hawkins, 2020; Hyndman, 2017; Jackman et al., 2020; Sammler, 2020; Satizábal & Melo-Zurita, 2021). However, although analysing dialectical relations between material and political agency has offered a new way of rematerialising the *geo* of geopolitics as such a new materialist approach reorients our focus on the materiality of the physical space through geopolitical interventions (Jackman & Squire, 2021; Peters et al., 2018; Sammler & House-Peters, 2023), there exists an epistemological debate on the use of the material (non-human) agency. That is because agency, 'the capacity to act', is often considered 'a solely human property' (Knappett and Malafouris, 2008, p. ix) as agency is often considered strictly connected to a conscious subject and their intention to act (Barad, 2007; Yusoff, 2013). However, such a formulation does not necessarily reflect how non-human (material)

has agency in enabling, constraining or imbricating political and human agency (Hickey-Moody, 2020; Yusoff, 2013). For that reason, understanding material agency requires expanding the scope of agency beyond human-centric subjectivity (Crane, 2021; Dasgupta, 2021; Fredriksen & Kuhn, 2023; Nowak & Roynesdal, 2022; Peterson, 2019; Sammler, 2020; Scott, 2009). With a new scope for considering multiple agencies, diverse scholars often think with different materiality of sites such as depth, height and volume, non-human bodies and geologic materiality to understand how such physical properties of the material sites are not just a backdrop of human-centric geopolitics but also can manifest as a way to control access to a physical space (Elden, 2021; Peters et al., 2018; Sammler, 2020; Squire, 2021). Therefore, we utilise new materialist interpretations of geopolitics to offer a way of analysing the nexus of bodily, volumetric space and geologic materiality in the case of tin diving.

Since rematerialising geopolitics offers geopolitical studies an understanding of the significance of physical spaces and landscapes such as mountains, atmospheres, undergrounds and infrastructures for the processes and practices of state-making and colonial control, social scholars have utilised such a material analysis of geopolitics in the context of political strategies in conflict and military campaigns. For example, Weizman (2004) argues that those who secure the underground and elevated spaces can control those within and without them from military and terrorist attacks, destabilising state sovereignty. Such control of the elevated space and underground is possible due to the use of technologies that support the state to use and access the air and subterranean spaces Field (Klinke, 2021; Klinke, 2021; Wilke, 2017). Meanwhile, reflecting on securing the 'area' during conflicts, Elden (2013) provides a thought-provoking reflection on the relationship between height, depth and power in subterranean and vertical territories by seeing an area as a volume instead of a flat surface. Following Elden's argument, Squire and Dodds (2019) also showcase how subterranean spaces inspire the development of the military bunker and the discharge of chemical agents as weapons to poison the underground water of an enemy. Inspired by the work of Sloterdijk's (2016) thinking with a foam as interlocked territory, such a volumetric space can be employed as a military weapon, such as the use of poisonous gas during the world war.

While the new materialist interpretation of geopolitics has been mostly the purview of combat and defence, other scholars have expanded the theoretical application of new materialism in geopolitics beyond the scope of state interests. For example, Scott (2009) has described how some terrains have particular materialities that can either assist or hinder a state's territory-making practices and colonial controls (e.g., taxable rice paddies in the valley versus camouflaged cassava plantings up the mountains). Squire (2021) also showcases how extreme pressure, temperature and depth on the seafloor have resisted and complicated the production of state-territory. More recently, Pauwelussen (2022) and Pérez and Zurita (2020) have demonstrated that non-state actors like divers can also utilise subterranean and seabed spaces for their own territory-making practices. This insight also means enacting alternative territorial practices beyond state reach can open up another geopolitical understanding of the intertwined bond between gender and space, as certain spaces have been framed 'in masculine terms' as a frontier to be invaded, attacked and domesticated (Squire, 2016, p. 2). These works have demonstrated how such materiality of the physical spaces and non-human actors can come together to create a way of assisting or resisting hierarchical and dominant state geopolitical interventions over the physical space, yet there is still work to be done conceptualising the role of material relations in geopolitics. In this way, Barry and Gambino (2020) assert that the material relations of seawater, oceanic depth, sands, seagrasses and pipelines can disrupt or facilitate the state-geopolitical project by being deployed as a 'tactical point' by different actors, as 'subsurface materials acquire geopolitical consequence' (Barry & Gambino, 2020, p. 110)

Building on feminist geopolitics, volumetric territory and social ocean studies, this paper expands the concept of a tactical point as to how seabed spaces of invisibility are found or created

at the nexus of volumetric space with embodied and material relations in seabed tin mining. This means that different actors from the provincial government, central government, mining corporations and tin divers utilise the volume-bodily-geologic materiality of the seabed as a tactical point to put the seabed to use for their interests. In the following sections, the empirical findings of the research explain how such tactical points have materialised in seabed tin mining.

4. THE GEOPOLITICAL GOVERNANCE OF THE SEABED TIN MINING IN INDONESIA

Indonesia does not use tin ores for its domestic markets, but instead relies on the international markets for tin export. As this mineral is explicitly an export commodity, Indonesian mining exporters and miners should comply with the standard mining practices set by the OECD. The OECD is an international organisation comprising 38 member countries that commit to specific rules regarding trade and economic development. Specifically, using their mineral price framework, they set rules for metals extraction and trade that include neither purchasing metals from dangerous mines nor those in conflict areas (OECD, 2022), shaping metal trades with impacts on their market price. Among their metal interests, OECD members also focus on governing tin mining. Tin is an important strategic metal for global electronic devices, automobiles and weapons manufacturing, worth over 20,000 USD per metric ton (Tresiera, 2019). The mineral price framework of the OECD not only considers global tin demand but also whether tin mining complies with their personal protective equipment (PPE), safe working environment and conflict-free mineral sourcing standards, shaping the global tin price and the domestic Indonesian tin price. To export tin ores from Indonesia to OECD members, Indonesia is presumed to comply with their standards (Ibrahim, 2015), which then fetch high prices from OECD members (e.g., international tin buyers and electronic device corporations) (Yulianti, 2020).

While Indonesian tin mining operations are obliged to comply with OECD standards to export this tin ore to OECD members, there are ways this mining compliance is subverted. For example, although the industrial-scale tin mining practices in Indonesia meet OECD standard mining practices, such as using PPE and having legal permits, artisanal mining, like tin diving, does not. However, large-scale mining companies and international tin buyers still purchase tin ores from tin diving operations. Tin divers can also trade their tin ores to Singaporean and Malaysian collectors and their mining companies that have already passed the OECD standard practice assessment by shipping their tin ores and ingots from Bangka Islands to these countries (Marjaya, 2020). With such a complex chain of international tin collectors, ores collected from tin diving continue to reach OECD members (Ranto et al., 2023). International tin collectors primarily prefer to purchase tin ores from tin divers since they can extract it from the seafloor without expensive technological and legal requirements, producing more affordable tin prices than their large-scale counterparts. That is because large-scale seabed mining must also pay revenue taxes and contribute to corporate social responsibility (CSR) payments (Jihan et al., 2021). This configuration of the legal and technological requirements has raised the large-scale seabed mining's operational costs and, thus, increased their tin price. Beyond just the price, purchasing tin ores from tin divers is easier, given the materiality of tin ore itself (Nugraha & Purwanto, 2020). That is because once legally extracted tin ores are mixed up with illegally extracted tin ores, the tin ores are then hard to distinguish through OECD's standard mining assessment to trace their origin.

Meanwhile, in addition to the physical property of the tin ores, regulatory intervention challenges also exist in governing and managing offshore tin mining operations in the field. With the current rising number of artisanal seabed tin miners, the provincial government only uses marine spatial planning (MSP) as a tool for governing activities offshore (see Figure 2). The MSP is a legal instrument designed, coded and charted by the Department of Fisheries and Marine Affairs and implemented by the provincial government. It allocates seabed space for tin mining and

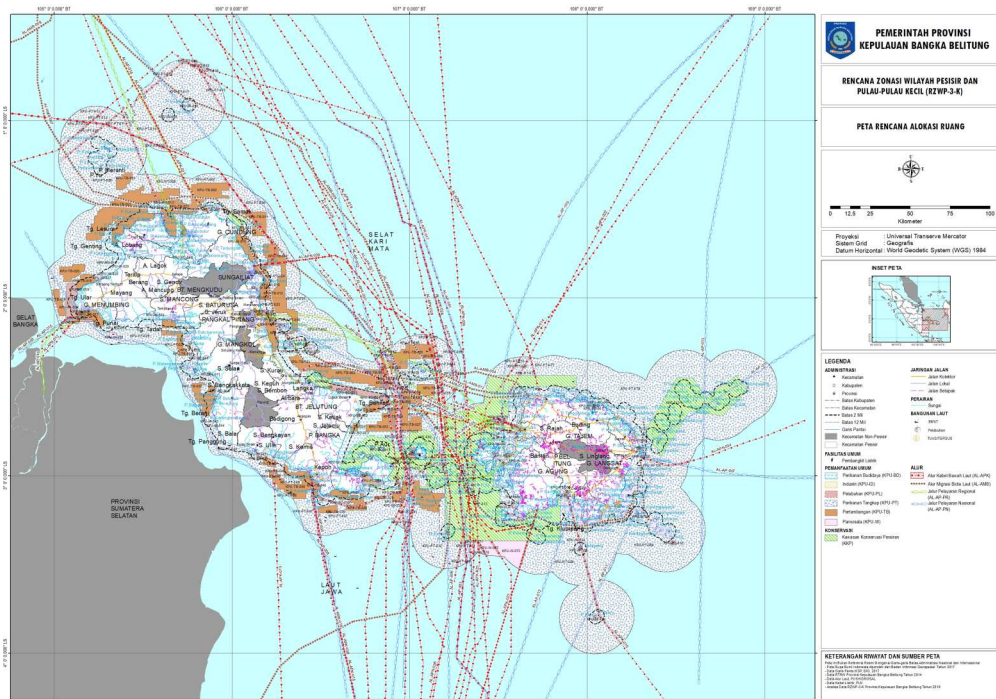


Figure 2. A flattened, two-dimensional map representing Marine Spatial Planning (MSP) off and on the Bangka and Belitung Islands.
 Source: PERDA (2020) and the MSP publication permission is given by the Department of Fisheries and Marine at the province level on Bangka and Belitung Islands, Indonesia.

other marine uses, such as the fishing of seabed-dwelling marine organisms (e.g., shrimps and sea cucumbers) and marine conservation. The hard-to-access seabed hampers the enforcement of the MSP interventions because seabed properties often destabilise the assumed power of central and provincial state governments to control and manage the seabed space by the depth and the invisibility of the seabed depth defying direct governmental control and monitoring. A governmental employee (2022) confirms this argument:

We always think within our MSP team that our seas are flat; that is our limitation. In general, I understand that we have to see the sea and seabed as a volume because, indeed, it has depth and height. Current MSP does not consider this volumetric space as part of crucial consideration to govern the seabed and marine uses. (Interview, 21 July 2022)

While the region’s MSP map delineates explicit spaces of use and jurisdictions of control, the provincial government does not have the undersea water sensing technologies to detect the existence of tin diving operations nor to prevent mining accidents. Indeed, the provincial government employees could see floating rafts from the sea surface. However, given the enormous number of floating rafts and the dispersed spatiality of the rafts, the provincial government officers also do not have adequate personnel and boats to access, monitor and enforce their mining rules for tin diving. Apart from that, as the provincial government considers tin diving illegal, given the non-compliance of the OECD’s personal protective equipment standard and their lack of mining licenses, the provincial government does not bother to stop the operation of tin diving operations. For that reason, the volumetric space of the seabed, from the surface

to below the sea, has arguably become an essential tactical point, especially for tin divers and buyers to resist regulatory intervention. For example, mining corporations do not need to recover the entire requisite of tin ores themselves but instead rely on purchasing some of their tin ores from tin divers (mining corporation representative, interview and discussion about when, where and why seabed tin deposit exists, 24 April 2022). Thus, they can employ tin divers' bodies as extensions of their industrial extraction activities. The invisibility of activities on the seabed challenges enforcement by the Indonesian government (MSP) and international governance apparatuses like the OECD.

The complexity of governing tin diving not only comes from technical difficulties but also from whether the current geopolitical governance should include their activities and accidents in legal reports. That is because, similar to Klein's (2022) study on tin mining in Madagascar, formalising tin diving can enable the state government to extract tax-based revenues from tin trade transactions while maintaining the dangerous activities that exploit miners' bodies. For that reason, legalising tin diving means tin divers' bodies can still be exploited through governmental tax payments while they remain susceptible to working accidents (Ibrahim, 2015). Given that regardless of whether legal or not, legalising tin divers does not reduce the number of tin diving accidents, this situation demonstrates that the regulatory intervention only benefits the government in collecting taxes from tin trade transactions. Thus, the inability to govern tin diving contradicts and challenges the ambition of the OECD and MSP, as these geopolitical governance instruments aim to reduce dangerous mining practices and spatial conflict. Additionally, due to the lack of measures to reduce tin diving accidents, they have failed to address tin diving safety and conflict issues. However, despite this failure, the relationship between geopolitical intervention and tin diving operations through tin trade transactions and taxation systems showcases how the bodily scales of tin diving and the global scale of geopolitics are connected by seabed space and the flow of seabed mineral resources.

5. SCALES OF SEABED TIN MINING OPERATIONS OFF BANGKA AND BELITUNG ISLANDS

Tin diving is an artisanal seabed mining technique that demands tin miners utilise air compressors, pipes, wood-made floating rafts (locally known as *Ponton*) and wet suits to descend into the sea's depths, 15–25 metres below the surface. They collect tin ore using pipes to suction sandy materials of the seafloor up to the surface. Through this practice, they create large seabed pits many more metres into the seafloor. Meanwhile, large-scale seabed mining in Indonesia requires expensive technologies such as cutter suction dredgers (CSD) paired with underwater sensing technologies (i.e., multi-beam echo sounders and digital seabed simulation maps), large vessels, and trained workers. The large-scale seabed tin mining can reach seabed depths of up to 60 metres. The scale of seabed mining also defines the way they interact with the seabed. For example, while large-scale seabed tin mining operations mediate human and seabed interactions through their mining technologies (Sammler & House-Peters, 2023), tin divers feel the seabed directly as they use touch, sight and sound to evaluate the texture, colour and other properties of the seabed. Thus, these different technological mediations, from large-scale seabed mining to tin diving, create different experiences of encountering the seabed. According to Tin diver 1 (2022), their embodied experience contests the meaning of how deep the seabed pit is beyond the common nominalisation of depths. As Tin diver 1 (2022) explains:

Author 1: Do you know how deep the seabed pit (*kolong*) is? (in person)

Tin diver 1: To me, the depth of the seabed pit is relative. Because, unlike common numerical measurements of the sea depth, using a barometer or a ruler. When I descended into the seabed pit, everything was

completely dark. As if I entered into the void. It was so deep that one cannot relate to what I feel if they themselves do not dive into the seabed pit. (Interview, 26 April 2022)

This understanding of the depth can differ from the way the provincial government sees the seabed with the MSP map, which does not consider such experiences of their territory. While divers often consider the volumetric space for their practices, state-governmental bodies oversimplify the space as a flat and un-lived territory (Zurita, 2019). The existence of seabed tin mining operations, regardless of industrial or artisanal scales, are spatially and temporally dispersed given that they depend on mineable tin deposits and sea weather. If the tin deposits are fully exploited or produce fewer tin ores that cannot buffer operational costs, seabed tin mining industries will find other productive seabed pits. Moreover, the consideration of waves and winds is important in searching for seabed tin mining. If the waves are over one metre in height, they will terminate their operations and move to other sites with wave-friendly mining. This is because waves can turn over rafts, boats and mining ships. Given the unpredictable movements of the sea and seabed, tin mining operations and limited mineable seabed tin deposits, both artisanal and large-scale seabed tin mining operations compete over seabed pits when they operate near each other (mining corporation representative, interview and discussion about when, where and why seabed tin deposit exists, 24 April 2022). These scales of seabed tin mining operations hence play an integral role in shaping the seabed into a political space, producing tactical points for miners to resist the current regulatory intervention. For instance, in the context of tin diving, the relations between the volumetric space of the seabed, tin divers' embodied experiences and tin ores have allowed tin divers to resist or assist particular geopolitical interventions like MSP.

6. THE MATERIAL AND VERTICAL ARRANGEMENT OF BODIES

Before the nineteenth century, British and Dutch settlers relied upon enslaved Chinese and Native Malay people to accumulate tin ores off the Bangka and Belitung Islands (Dunia Tambang, 2020; Erman, 2017). European settlers categorised enslaved people into a social hierarchy. The social strata of enslaved Native Malay people were lower than that of enslaved Chinese people, given that enslaved Chinese people could identify tin ores as opposed to *Kong* (Ancient Chinese language for bedrock) in seabed sediments. Even though the strata of the enslaved Native Malay and Chinese people were different, their bodies were both lower in the strata than the bodies of Dutch and British settlers and tin ores. Such socioeconomic stratum manifested in a material and vertical arrangement as the enslaved Native Malay people were tasked with diving into the seabed pits, where enslaved Chinese people stayed at the sea's surface, charged with collecting the tin ores from tin divers (Research Diary, 2022).

On the surface, enslaved Chinese people would wash the sediments to separate tin ores from sand and other minerals. They also tasted the clay with their tongues to determine whether the divers had reached *Kong* (bedrock). Salty clay meant they could continue digging, whereas tasteless clay implied that they had reached bedrock. Geologically, this saline sensing worked because the bedrock's porosity is impenetrable to saline water and tin ores (geologist, interview about offshore tin mining operations, 15 July 2022). There are no tin ores below the bedrock, so it is no longer worth digging. After the tin diving operations, the enslaved miners gave the collected tin ores to the Dutch settler-owned companies such as Banka Tin Winning Bedrijf (BTW), Mijnbouw Maatschappij Biliton (GMB), and Singkep Tin Exploratie Maatschappij (NV. SITEM) (Gunawan, 2019; Ibrahim et al., 2018). Tin divers still continue the practice of detecting tin ores and bedrock as the geologist (interview about offshore tin mining operations, 15 July 2022) explains:

First author: I wonder how tin divers actually could identify the tin ores although they mostly do not go to a formal school to study geology?

Geologist: We [the Indigenous Malay] actually learn how to identify Kong and tin ores from the knowledge of enslaved Chinese people about tin geology that is passed from generation to generation. Kong, in current geological knowledge, is bedrock. You could taste the clay collected by tin divers using your tongues. If it is not salty, it is Kong. Meanwhile, you could identify the tin ores from the black colour of tin ores and usually, tin ores could resist the water flow from the suction pipes.

With such geological knowledge of tin ores, many on these islands could partake in seabed mining. However, these days, to minimise the seabed tin mining operations' detrimental impacts on the marine environment, the provincial government obligates every tin miner and corporation to possess mining licences (PERDA, 2020). However, most tin divers cannot compete to acquire the permits because private and state-owned mining companies own most concession areas. Without mining licences, the provincial government labels tin diving as illegal. Marking their tin extraction as illegal, the provincial and central governments have made tin diving operations invisible to the administration. As marine ecologist I (interview about seabed tin mining operations, 11 May 2022) explains, 'Given that so many tin diving operations on Bangka and Belitung Islands in Indonesia do not have legal mining permits, the government does not record the number of tin divers'. A governmental employee (interview about the current limitation of marine spatial planning (MSP) to govern the seabed and sea space in Indonesia and Bangka and Belitung Islands in Indonesia, 21 July 2022) also confirms: 'We do not record any tin diving operations because it is not according to international mining health and safety standards; for mining corporations, if they buy tin ores from tin divers, they risk to destabilise Indonesian tin price'.

This distinction between legal and illegal mining has created the assumption that tin ores exported worldwide from Indonesia are not coming from 'illegal' tin diving. This maintains the appearance of seabed mining that complies with OECD standard mining practices, allowing tin exports to this important market and stabilising Indonesian tin prices. However, if the OECD acknowledged the trade between tin diving and large-scale tin mining operations, Indonesian tin exports would be jeopardised. While legal large-scale tin mining often complies with the OECD's PPE requirement, tin diving operations do not meet their health and safety protocols (OECD mineral guidelines, 2022) because they lack the financial resources to purchase PPE and work in a high-risk working environment.

Whilst the tin divers' bodies are excluded geopolitically, large-scale private tin mining operations have primarily relied on tin diving operations, given the cheap labour and affordable tin ores that tin divers produce (environmental sociologist, personal communication about the history of seabed tin mining operations on the Bangka and Belitung Islands, 24 April 2022). To supply tin ores to private tin mining companies, tin divers enter into the seabed pits and vacuum tin ores. However, this corporeal human and seabed interaction is not without consequences. Their bodies, while descending to and extracting tin ores from the seabed pits, can be buried by the collapsing seabed pit walls. Survivors often suffer psychological, physical and physiological trauma. As marine ecologist I (interview about seabed tin mining operations, 11 May 2022) explains how

many tin divers experience decompression sickness due to the long duration of diving [seven to eight hours per day]. It is the condition by which nitrogen residues flow excessively into their bloodstreams. Consequently, they mostly suffer from a heart attack, numbness (stroke) and hearing impairment.

Moved by the lack of official tin diving accident reports, the Indonesian Forum for Living Environment (Wahana Lingkungan Hidup Indonesia, WALHI), a non-governmental

organisation, began collecting data. They reported that tin diving operations claim the lives of at least one hundred people per year, likely more than that in actuality (WALHI, interviews about offshore tin mining operations and artisanal seabed tin mining on Bangka and Belitung Islands, Indonesia, 5 June 2022). To this end, what remains the same from the colonial era to the present moment, is that through vertical and material arrangement, tin divers' bodies are made less important than the tin ores they collected. This has to do with the provincial government and mining corporations focused on collecting revenues and taxes from tin accumulations without consideration for tin divers' bodies recovering tin ores, often injured, trapped and buried alive under the seabed (WALHI, interviews about offshore tin mining operations and artisanal seabed tin mining on Bangka and Belitung Islands, Indonesia, 5 June 2022). The provincial government does not publish official reports on the number of current tin diving operations or their mining accidents. The non-profit organisation WALHI recorded that tin diving can claim 100 lives annually, with many of them undocumented in the official governmental mining reports, and their bodies are rarely recovered, becoming lost to the seabed pit, becoming part of it (WALHI, interviews about offshore tin mining operations and artisanal seabed tin mining on Bangka and Belitung Islands, Indonesia, 5 June 2022). Meanwhile, the narrative of illegality in tin diving has further become a tactical point for justifying the government's decision not to record tin diving accidents, excluding the already invisible tin divers' bodies on the seabed (WALHI, Interviews about offshore tin mining operations and artisanal seabed tin mining on Bangka and Belitung Islands, Indonesia, 5 June 2022).

7. THE VOLUMETRIC SPACE OF THE SEABED AS A TACTICAL POINT

The embodied experience of tin divers interacting with the seabed's volumetric space signifies the difficulty of accessing the seabed pits. For example, tin diver 2 (interview with tin divers to understand their tin diving experience, 20 June 2022) explains:

At 7.00 am, we, tin divers, descend to the seabed pits with the approximate width and depth of 15 and 18 metres, respectively. It is always scary to be in this hidden space, yet, at the same time, the seabed pits provide us an opportunity to improve our livelihoods. Within this seabed space, we feel the water pressure and temperature (15 °C), rocks, sands and sea urchins with our physical bodies. We can only feel the physical properties of the seabed pits with our skins but cannot see as they are completely dark.

While seabed access is often interpreted linearly to benefit mining corporations by not requiring them to collect tin from the seabed but instead relying on tin divers, recentring on the volume of seabed pits proffers an understanding of how the volume can be useful for different actors. That is because the seabed's volume and materiality can become tactical points for tin divers, mining corporations and the governing authority to secure tin ores. The notion of who benefits from the seabed pits depends on how they use the volumetric space of the seabed, how they are used in larger mining markets and the hierarchy of bodies in colonial relations. For example, Jackman and Squire's (2021) argument about securing vertical spaces to survey and constrain mobility can be applied to tin diving operations because the provincial government uses the capability to control the mobility of tin divers from land via taxation to secure continued benefits from tin diving operations (Figure 3).

Tin divers stay in the seabed pits for about two to seven hours, either all in one go or diving up and down for several hours, depending on the pit's productivity. Once they recover tin ores, they must swim to the surface to rest and perform tin transactions with large-scale mining corporations on the coast. Meaning they return to land, where their activities are more easily regulated and controlled by the provincial government. Meanwhile, under the seabed, they can resist regulatory interventions by diving, digging and extracting invisibly. Although they kick off seabed



Figure 3. A tin diving member sitting atop seabed sediments mixed with tin ores on a wooden floating raft, holding a yellow breathing pipe.

Source: Personal documentation, 2022.

plumes as an outcome of their extraction practices, their invisibility showcases the difficulty of enforcing any regulatory intervention at sea. As the research diary explains,

From the mining ship, I asked CSD operator, are they (tin divers) not working today? CSD operator replied they were still collecting tin ores. But indeed, they are invisible due to being under the sea. It is interesting, isn't it? We cannot see how chaotic and busy their work is on the seabed. However, from a governmental perspective, not only [do] they have difficulty controlling tin divers due to their numbers but also due to their hidden mining sites. (Research Diary, 2022)

Tin diver 1 (2022) confirms this note:

When I was under the seabed, it was *liberating*. Nobody, including the government officers and my wife, can tell me what I should or should not do. I can focus on listening to the flow of tin ores through my suction pipes; it makes me happy, though I know the risk of getting buried alive under the seabed can happen anytime. (interview on 26 April 2022)

The liberation referred to here means that tin divers can escape family conflict and expectations given unstable economic pressures. In this way, they are willing to take risks in performing tin diving to prove themselves, and even their masculinity. For example, tin divers have associated tin diving with the notion of ‘the man’s work’ (tin diver 1 interview on 26 April 2022). As tin diver 2 (interview with tin divers to understand their tin diving experience, 20 June 2022) explains, ‘Tin diving is a man’s work. Not only because only men collect tin ores, but you must also accept the uncertain dangers associated with this practice that make us real men’ (interview on 22 June 2022). This finding echoes Melo Zurita’s (2019) and Paulwelusen’s (2022) arguments about how masculinity construction has been used to normalise dangerous underwater labour practices. The risk of tin diving is primarily getting buried by the collapsing seabed walls (marine ecologist I interview about seabed tin mining operations, 11 May 2022) (Figure 4).

While tin divers are prone to being buried by the precarious wall of the seabed pits, they are also susceptible to exploitation by the ruling bodies back on land. By focusing on generating tin ore tax revenue, the provincial government reduces tin divers’ bodies into living tools to collect tin ores from an extremely hostile environment. Additionally, the volume of the sea can help the provincial government mask their incapability to minimise the number of mining accidents in the seabed pits because the pits are often invisible due to their depth and the opaque waters above, obscured by seabed plumes (Figure 5).

Given active tin removal in tin diving, the agency of the seafloor becomes activated by its various characteristics, such as depth, volume and the materiality of the seabed pits. These variables can be harnessed to benefit mining corporations and central and provincial governments. But it also can become a space of resistance for tin diving operations because it is, in practice, ungoverned, allowing divers to extract an artisanal livelihood from the seabed pits. The depths and

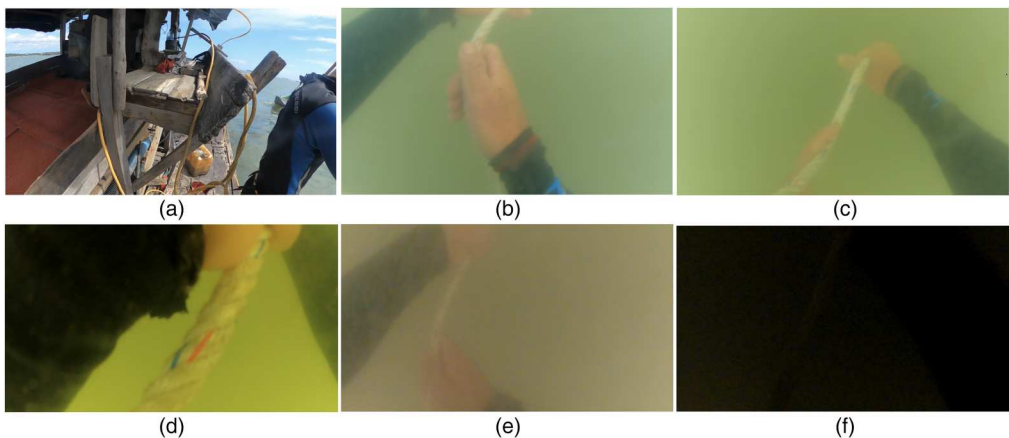


Figure 4. The process of descending into the seabed pit. (a) A tin diver is wearing a wet suit on a wooden floating raft offshore. (b) Using a rope tied to a cemented weight to orient the diver’s body to the seabed pit to avoid getting swept away by the ocean current using the rope to orient the diver’s body to the seabed pit. (c) As the tin diver goes deeper using the rope, the water’s colour changes to green. (d) The water then changes to yellow. (e) The water’s colour turns grey as the tin diver approaches the seabed pit. (f) When the tin diver reaches the seabed pit, the water’s colour turns dark.

Source: Personal documentation, 2022.



Figure 5. Tin floating rafts operating offshore Bangka and Belitung Islands.
Source: Personal documentation, 2022.

volumes under the sea challenge top-down political interventions due to the difficulties surrounding the control of seabed access. The provincial and central government often cannot access the unstable and undulating sea surface nor the seabed pits, let alone control the access of others. With this hard-to-access seabed site, tin divers can utilise these limitations as an opportunity to extract tin ores without rule enforcement and surveillance. For example, given the difficulty of accessing and controlling the seabed tin mining sites, tin divers can export the surplus of tin ore production using boats to tin collectors in Singapore and Malaysia without getting caught by the marine police (marine ecologist II, interview on 26 April 2022).

8. TIN ORES AND THEIR GEOPOLITICAL COMPLICATIONS

While the two previous sections have focused on embodied experiences and volumetric spaces concerning practices on the seabed, tin ores must also be considered the tactical point in the politics of territory-making on and through the seabed. Tin ores within the seabed pits complicate the calculation of seabed tin deposits. It is because the alluvial tin ores follow the gravity rule: their molecular density (7.28 grams per cubic centimetre) is heavier than clays and sands (Taylor, 2014), sinking the ore deeper than the overlying materials. Tin ores situated deep beneath the seabed and combined with the fluid materiality of the sea resist straightforward state regulatory interventions and calculative tax estimations. This technical challenge of securing the seabed pit and calculating the tin reserve value has often posed a tremendous economic and ecological threat to the provincial government. They cannot secure the seabed space for either legal seabed mining or marine conservation projects. Yet tin divers and mining corporations can benefit because they are the actors that can calculate and access tin ores at the seabed.

In this respect, the relationship between the (in)accessibility of particular landscapes and the ability to resist state surveillance and intervention (Scott, 2009), tin ores shrouded by multiple layers of seawater and seabed sediment, can sometimes help tin divers resist unfair regulation

and taxing systems. An unfair system because it extracts resources for the state without the government providing services, such as safety in the offshore mining industry. Tin diving operations are also influenced more by the spatiality of seabed tin deposits in the seafloor than the surficial ordering of MSP maps. This is one of many ways that tin ores have a material agency that shapes the politics of territory-making practices in marine space. As one mining corporation representative explains (2022): 'For all tin miners, regardless of the large and artisanal scales, we follow alluvial tin ores. Alluvial here means the stream or the flow of the tin ores ... like a river of tin ores beneath the land. It flows from the terrestrial land and rivers to the sea. Theoretically, tin deposits in the terrestrial land and nearshore were exhausted, and thereby, we went offshore and deeper beneath the sea' (interview on 24 April 2022). That said, the tin divers do not follow MSP maps, which assumes that tin divers do not go to fishing or marine protected areas off the Bangka and Belitung Islands. Instead, they follow alluvial tin ores regardless of their location. As the discussion with a tin diver explains:

First author: What motivates you to dive and collect tin ores from the seabed? (in person)

Tin diver I: You can say that it is because tin ores are our means of providing livelihoods to our families. So, tin ores have become our main motivations to continue diving as a means of providing a living to my family. (interview on 26 April 2022)

In this way, tin ore's value encourages tin divers to continue to dive, tin ores also perpetuate conflicts between tin divers and other marine users. The conflict here is urgent because it can involve verbal and physical violence between tin divers and other marine users (mining corporation representative, interview and discussion about when, where, and why seabed tin deposit exists, 24 April 2022). In addition to that, the existence of tin ores changes the topography of the seabed because wherever tin ores exist, and the depths are accessible, there will be tin divers and other seabed tin mining operations dredging and vacuuming the seabed. Thus, tin ores and seabed tin mining operations co-shape the features and geography of the seabed. The product of the tin ore and seabed tin mining operation co-production is the seabed pit in itself. Thus, the spatiality of this mineral challenges the effectiveness of flat geopolitics on the Bangka and Belitung Islands.

9. CONCLUSION

Attending to volume, bodies and tin ores provides a crucial geopolitical reflection of how the seabed has become a geopolitical site because it demonstrates how the material relation of tin divers' bodies, tin ores and the volumetric space of the seabed have become the tactical points in the politics of seabed territory-making. While a flat geopolitical approach occludes tin divers in their seabed interventions, examining their embodied experiences reveals how human, water and ore bodies have been arranged vertically and materially, starting with British and Dutch colonial settlers, and still existing today. Additionally, this work makes visible, or sensible, tin divers' bodies which are often left officially undocumented and ungoverned within the current regulatory intervention. Meanwhile, from the perspective of mineral extraction, the politics of making tin divers' bodies invisible are crucial for the provincial government and mining corporations that collect taxes and profit from their hidden labour. Removing and erasing tin divers from official record-keeping maintains the appearance of compliant seabed mining with OECD's standard mining practices and the stability of Indonesian tin price, though it also means normalising the death and dangers of tin diving. If the provincial government reports the number of tin diving operations and their mining accidents, this evidence will undermine the Indonesian tin ore price because the OECD ideally only recommends international tin buyers purchase from miners

using PPE. However, the issues with tin extraction are complex because tin divers trade their ores to domestic large-scale mining corporations and tin buyers in Singapore and Malaysia.

This paper has demonstrated the role of the seabed as a volumetric space and its geopolitical implications. Not only is the seabed an arena of conflict between tin divers and other marine users, but also proffers tactics for them. Those who can access the volumetric space can benefit most from the seabed. In this respect, tin divers and mining corporations use the hard-to-access seabed pits as a form of resistance against regulatory interventions. Especially since the provincial government cannot access and estimate tin wealth beneath the seabed for taxes, mining corporations can escape from the regulatory intervention that constrains the space for mining operations by relying on tin diving. That is why the existence of the volumetric space like the seabed pits indeed becomes a reminder that regulatory intervention like MSP ceases to apply mainly due to the inaccessibility of the seabed.

Beyond the agency of volumetric space and embodied experience, the material agency of tin ores is crucial for the politics of the seabed territory making because it arguably shapes the seabed and their utilisation more than the MSP can in allocating and controlling marine and seabed space. In fact, instead of complying with the flat geopolitical prescription for marine and resource space allocation, tin divers and mining corporations follow the stream of tin ores beneath the seabed. Thus, the spatiality of the tin ores complicates the way of governing seabed tin mining operations on Bangka and Belitung Islands, given that the existence of tin ores does not abide by the MSP.

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