"Blood on the floor": The nickel commodity frontier and inter-capitalist competition under green extractivism

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Abstract

Major companies in the mining industry are strategizing to benefit from the expected rise in demand for energy "transition minerals" that underpin current technologies of decarbonization (such as batteries and wind turbines). This article elucidates their current strategies of accumulation through the case of BHP, the world's largest mining company. We draw on political ecology and commodity frontier theory in order to grapple with inter-capitalist competition under the current moment of green extractivism by examining firm and state practices in the nickel commodity frontier. Empirically, we examine the changing role that nickel has played in BHP's asset portfolio during the past decade where it has attempted to significantly accumulate from the expansion of the nickel commodity frontier. Yet, despite this centering of the expansion of the nickel commodity frontier for its particular strategy of accumulation under green extractivism, it has so far been unsuccessful. Given this potential for failure of company practices in commodity frontiers, we argue that green extractivism should not always and everywhere be seen as a story foretold.

Key words: transition minerals, accumulation strategies, global supply chains, market dynamics

Résumé

Les grandes entreprises de l'industrie minière élaborent des stratégies pour bénéficier de l'augmentation attendue de la demande de "minéraux de transition" énergétiques qui sous-tendent les technologies actuelles de décarbonisation (telles que les batteries et les turbines éoliennes). Cet article élucide leurs stratégies actuelles d'accumulation à travers le cas de BHP, la plus grande société minière du monde. Nous nous appuyons sur l'écologie politique et la théorie de la frontière des matières premières pour aborder la concurrence intercapitaliste dans le contexte actuel de l'extractivisme vert, en examinant les pratiques des entreprises et de l'État dans la frontière des matières premières du nickel. Empiriquement, nous examinons le rôle changeant que le nickel a joué dans le portefeuille d'actifs de BHP au cours de la dernière décennie, pendant laquelle la société a tenté d'accumuler de manière significative de l'expansion de la frontière des matières premières du nickel. Cependant, bien que l'expansion de la frontière du nickel soit au centre de sa stratégie particulière d'accumulation dans le cadre de l'extractivisme vert, elle n'a jusqu'à présent pas réussi à s'imposer. Compte tenu de ce potentiel d'échec des

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pratiques des entreprises aux frontières des matières premières, nous soutenons que l'extractivisme vert ne doit pas toujours et partout être considéré comme une chronique annoncée.

Mots clés: minéraux de transition, stratégies d'accumulation, chaînes d'approvisionnement mondiales, dynamique du marché

Resumen

Las principales empresas de la industria minera están elaborando estrategias para beneficiarse del previsible aumento de la demanda de "minerales para la transición energética" que sustentan las actuales tecnologías de descarbonización (como baterías y turbinas eólicas). Este artículo analiza sus actuales estrategias de acumulación a través del caso de BHP, la mayor empresa minera del mundo. Nos basamos en la ecología política y en la teoría de las fronteras de commodities para abordar la competencia intercapitalista en el actual momento del extractivismo verde, examinando las prácticas de las empresas y del Estado en la frontera del níquel. Empíricamente, examinamos el papel cambiante que el níquel ha desempeñado en la cartera de activos de BHP durante la última década, en la que ha intentado aumentar la acumulación significativamente a partir de la expansión de la frontera del níquel. Sin embargo, a pesar de centrarse en la expansión de la frontera del níquel para su estrategia de acumulación en el marco del extractivismo verde, hasta ahora BHP no ha tenido éxito. a partir de este potencial de fracaso de prácticas empresariales en las fronteras de commodities, sostenemos que el extractivismo verde no debería verse siempre y en todas partes como una historia anunciada.

Palabras clave: minerals para la transición energética, estrategias de acumulación, cadenas mundiales de suministro, dinámica del mercado

1. Introduction

> Carmakers, miners and battery groups are jostling to position themselves in the new Darwinian world [...] We may be coming to a world in which the market becomes very brutal. There will be a small number of winners, a lot of losers and a lot of blood on the floor. (*Financial Times*, 2023)

Just a few years ago, the energy transition and the associated uptake of electric vehicles was conceived as something of a boon for the participating actors: carmakers, miners and battery groups. As the quote from the *Financial Times* (FT) above suggests, it is turning out to be a somewhat rockier ride than first envisioned. Rapidly changing battery technologies mean rapidly changing and dynamic market conditions and consequently, "a winner today could be a loser tomorrow and a loser today could be a winner tomorrow", as a Belgian supplier of specialized chemicals for batteries put it in the same FT article (Campbell *et al.*, 2023).

In this article we contribute to debates in political ecology on green extractivism by 'looking up' towards those capitalist actors that are battling it out among each other in the new Darwinian world. Focusing our attention more particularly on mining companies, we elucidate how they are trying to link up to the emerging supply chains around the technologies of decarbonization associated with the so-called energy transition, especially electric vehicles (EVs). The dynamics of cut-throat competition along with geopolitical tensions that characterize these supply-chains of so-called 'transition minerals'[2] are significantly reshaping *where*, *how* and *how much* mining takes place as a result of mining company strategies seeking out those minerals that underpin these supply chains.

We develop our analysis in conversation with political ecologists examining green extractivism, i.e. "resource extraction linked to or justified by the 'green' economy" (Verweijen & Dunlap, 2021, p.5). Existing work

[2] This along with "critical minerals" is a dynamic label, which is defined differently by different actors according to particular political and economic interests. We here use it as a shorthand for those minerals that are becoming of increasing interest for capitalist actors in light of the technologies associated with the energy transition. This is narrower than "critical minerals", which include those for military or other wider economic purposes. Of course, many that can be used for the transition can also be used for other purposes (as is the case with nickel), but we are specifically interrogating changes in the nickel commodity frontier arising from the emerging end-use in electric vehicles. Unless quoting others, we therefore use the term "transition minerals" throughout.

in political ecology on green extractivism is importantly examining the ecological destruction, dispossession and violence that it entails while conceptually developing and expanding the term green extractivism itself (Bruna, 2022; Dunlap, 2019; Dunlap & Jakobsen, 2020; Verweijen & Dunlap, 2021; Dunlap & Riquito, 2023). Most recently, attention is also being paid to how green extractivism "produces new extractive frontiers … [through] new avenues for 'green' investments and markets" (Tornel, 2023, p.6). Building on this work in political ecology, we understand green extractivism as a *moment* of expansion and reconfiguration of the geography of extraction of transition minerals influenced by states, and potentially offering new profit opportunities for the mining companies involved. It is this moment, as in a period of time, of green extractivism that has created the Darwinian world that the *FT* writes about above. Consequently, we are interested in what green extractivism means for mining company strategies of accumulation. As noted by Gavin Bridge (2000, p. 244-245) over 20 years ago, the geography of mining company strategy "is not immutably driven by mineralogy alone, but by its intersection with economic and political considerations, particularly those about the rate of profit that can be obtained from a particular deposit in comparison to opportunities for profitability that may exist elsewhere." So how are mining company strategies forming or being reshaped under green extractivism?

We examine this question through the case of the transition mineral nickel and through elucidating how the largest mining company in the world, BHP, has attempted, but as of yet is actually failing, to significantly accumulate through the expansion of the nickel commodity frontier. Despite BHP's centering the expansion of the nickel commodity frontier for its strategy of accumulation under green extractivism, it has so far been unsuccessful. We use the case of BHP and its relative lack of success to emphasize how green extractivism should not be understood as "a faceless, 'structural force'" and a foregone conclusion but as constituted by "the mundane workings of states and firms" as these seek to expand and direct particular commodity frontiers (Arboleda, 2020, p.22). States, and especially firms, routinely fail in their efforts (Shaikh 2016) – not least in the intensely competitive dynamics we find under the moment of green extractivism. Although a research agenda in political ecology and related fields is emerging around various transition minerals (especially lithium, see e.g. Bustos-Gallardo *et al.* (2021); Dunlap & Riquito (2023)), nickel has so far received less attention, with notable exceptions such as Voskoboynik & Farrugia (2022).

We contribute to this emerging agenda by following Jason Moore's (2010a, p. 34) approach to commodity frontiers, defined simply as "the geographical expansion of commodity production and exchange." In our analytic, green extractivism is constituted by changes in commodity frontiers. Examining the nickel commodity frontier and BHP's strategies thereby gives us a window into the broader political economy and ecology of green extractivism. Moore's (2011, p. 16) "capital-centric approach" [3] is useful for our endeavour in that it suggests an empirical focus on the driving force in the process of commodity production and exchange: namely corporations of various sorts – which is fitting for our focus on BHP.

Our data-gathering process was supported by insights from the online course provided by Corporate Watch that gives practical research training for studying the practices of companies. Following the method suggested there, before turning to BHP specifically, we started our interrogation by gathering an overview of the strategies pursued by the 'majors' within the mining industry. We participated digitally in the annual Financial Times Mining Summits (2021-2023), that while not using this term, were essentially focused on challenges and opportunities for advancing green extractivism. We gathered data from the different panels, in the form of quotes from interviews, presentations and debates, with notable figures in management from the mining industry and other capitalist actors supporting and/or dependent on it (e.g. investment managers, auto-manufacturers). References are made in footnotes to the specific panels at the summits from which quotes were taken. To situate and triangulate the opinions gleaned from these summits in the broader context of dynamics within the mining industry, we draw on industry data and analysis (e.g. reports by multilateral institutions, industry journals, the financial press along with statistics from IMF and the Australian Bureau of Statistics). Once we had this more general overview of the mining industry, we zoomed in on BHP. The data sources for our analysis of BHP consist of the company's own

[3] His approach therefore distinguishes itself from other research mobilizing the 'frontier' lens more in terms of a discursive and ideational process (see e.g. Tsing, 2003, 2005; Klinger, 2018) and/or focusing on other dynamics around frontiers such as re- and de-territorialization (Rasmussen & Lund, 2018), subjectivities (Verweijen *et al.*, 2023) and much more. For a sharp review and discussion of frontier literature see Kröger & Nygren (2020).

disclosures, including annual reports and press statements, along with – again – coverage of the company in industry journals and financial press. Our data search was targeted towards the changing role of nickel in the company's 'asset portfolio.' Our analysis of this subsequently consisted of the "detective work" (Mitchell, 2021, p. 919) of piecing together the company's strategies from these empirical materials.

In the next section, we lay out our theoretical framework, elaborating how we understand green extractivism to be constituted by changing commodity frontiers, which are in turn constituted through company and state practices. Section 3 gives a brief historical overview of the nickel commodity frontier before turning to the current 'Darwinian moment' referenced above. We show how recent market and technological changes have significantly re-shaped the viability of accumulation strategies across the commodity frontier. This is crucial context for our main empirical Section 4 that examines BHP's accumulation strategies towards nickel over the past decade, showing how the company has tried, but as of yet is failing, in its endeavours. Finally, we conclude with some reflections on the analytical and – more speculatively – possible political implications of the contribution.

2. Theoretical frame: Commodity frontiers under green extractivism

In this section we show how we understand the relation between commodity frontiers and green extractivism. To do so, we engage work on the political ecology of green extractivism along with Jason Moore's work on commodity frontiers, and conceptualize how these shape and are shaped by company and state practices.

"Capitalism," according to Moore (2011, p. 34), "does not have an ecological regime; it is an ecological regime. Or rather, capitalism is constituted through a succession of ecological regimes that crystallize a qualitative transformation of capital accumulation." Although not necessarily using Moore's vernacular, political ecologists working on green extractivism are grappling with how the rise of the 'green economy' and the energy transition during the 2010s has ushering in what Moore calls a new ecological regime. For political ecologists, the so-called green economy and the associated notion of sustainable development does not merely legitimize existing types and forms of extraction, but particularly in the midst of the energy transition it "creates new economic opportunities for mining and energy companies" (Verweijen & Dunlap, 2021, p. 5). Consequently, Voskoboynik & Andreucci (2022, p. 802) have argued that green extractivism entails a "new phase in the complex relationship between mining and environment" due to how "extraction and valorisation of mineral resources is rendered not only compatible with sustainable development, but necessary to it." This 'rendering' is much more than a discursive exercise in that state-driven efforts towards increasing development and adoption of technologies that underpin the energy transition are encouraging the extraction of transition minerals at an unprecedented scale (see e.g. IEA, 2021; World Bank, 2020). Following Verwiejen & Dunlap's (2021) distinction between direct and indirect forms, these state practices are leading to the dramatic expansion of *indirect* green extractivism, namely the expansion of the extraction of the particular minerals that are the basis of the supply chains of the decarbonisation technologies (e.g. wind turbines and electric vehicles).

Jason Moore's (2010a, 2010b, 2011, 2015) notion of commodity frontiers is useful to interrogate these dynamics of indirect green extractivism. As noted above, work on the political ecology of green extractivism emphasizes how it "produces new extractive frontiers" (Tornel, 2023, p. 6; Dunlap & Riquito, 2023; Andreucci *et al*., 2023). However, with our definition of green extractivism as a *moment*, i.e. a temporal phenomenon, we understand commodity frontiers as *constitutive* of green extractivism. For our purpose then, green extractivism is underpinned by the expansion of particular transition mineral commodity frontiers.

Commodity frontiers take historical and geographical form through commodity *widening* and *deepening*. Widening entails the move of production into new geographical spaces allowing for the appropriation of "high ecological surplus" (Moore, 2011, p. 25; 2015, p. 95). These surpluses stem from spaces that are zones of minimal commodification, allowing for enhanced opportunities for accumulation as these spaces and their resources are not already directly 'valued' by capital. The widening process thus entails the continuous hunt by individual capitalists for what Moore (2015) calls 'Cheap Nature,'. Deepening, on the other hand, entails expanded accumulation through the increased capitalization in existing sites of production as the ecological surplus is gradually exhausted. This necessitates increases in productivity through "new technologies and scientific understanding and techniques and forms of organizing labour" (Campling & Baglioni 2020: 262). In this manner, where the widening strategy will characterize the early stages in a new geographic frontier, the deepening strategy

characterizes more 'mature' frontiers as the period of high ecological surplus comes to an end, necessitating innovation to enable an acceptable level of profitability (Moore, 2011; Campling, 2012).

In the example of a given commodity frontier, e.g. nickel as examined by Andreucci *et al*. (2023), both the widening and deepening dynamics can be at play in different places at the same time. The nickel commodity frontier may be expanding into new geographic spaces in one place through company explorations (widening), while somewhere else being deepened by other companies through development of new technologies of extraction. Commodity frontiers are given dynamism through capitalist competition around the profit motive, which "acts as a kind of gravitational field, shaping broad patterns, yet allowing significant contingency" (Moore, 2015, p. 52). This contingency plays out through individual firm-level strategies and the choices they make around their investments – whether to widen or deepen, and where. Under "the surreal compulsions of ceaseless competition" characterizing capitalism generally, but the current 'Darwinian world' in particular, such strategies are a matter of survival (Moore, 2011, p. 18).

Companies make these decisions "in the face of an intrinsically indeterminate future, one that remains to be constructed" (Shaikh, 2016, p. 259). While they obviously play a key role in constructing that future through their investment decisions, under green extractivism, states are also playing an active role in trying to direct and shape commodity frontiers. In mining, this plays out more concretely through struggles around access to, and control of, land and whether and how the state as a 'landlord'[4] is able to appropriate rent from and set the broader conditions through which resource extraction can take place. Such dynamics involving the state as 'landlord' emphasize state practices *directly* through the production-side of commodity frontiers, when they exert territorial control over what Moore (2015, p. 131) calls the "exporting zones" of commodity frontiers.

However, the state can also seek to conduct commodity frontiers *indirectly* from the exchange-side through trade and industrial policy that shape extraction outside of its territory through changing "the conditions for accumulation around new technologies" that mined material is ultimately used for (Bridge & Faigen, 2022, p. 7). Under green extractivism, this dynamic is playing out through increased emphasis in state policy on defining and securing access to and control of the transition minerals that underpin energy transition technologies (Bridge & Faigen, 2022; Riofrancos, 2023). Heightened geopolitical tensions and US- and EU-efforts at decoupling decarbonization technology supply chains – especially from China – are therefore having significant impacts on the geography of transition mineral commodity frontiers through the shaping of mining company strategies. An example is the USA's Inflation Reduction Act, making supply chains that completely circumvent China more profitable. As noted by an Australian mining company:

> In the past, you sought to deploy capital in the most efficient location that made sense without reference necessarily to the geopolitical impact of that, so: where does it make sense from a capital and operating cost point of view to build each part of the [supply] chain. We can't do that anymore.[5]

The nickel commodity frontier is an emblematic case of these broad dynamics around transition mineral commodity frontiers.

3. The nickel commodity frontier under green extractivism

In this section we briefly trace the historical evolution of the nickel commodity frontier, before turning to the most recent dramatic reshaping of it during the energy transition. We trace how various states have sought to shape the commodity frontier under green extractivism, but how the 'gravitational field' of profitability is pulling the production side of the frontier towards Indonesia. This gives crucial context for BHP's strategies that are covered in Section 4.

[4] Though as shown by Capps (2016), various non-state institutions can also assume this role, in Marxist terms the class-function of modern landed property.

[5] Chairman of IGO, in Geopolitics of critical minerals panel at FTMS, 05/10/2023.

As a so-called base metal, nickel is already widely used in a range of conventional technologies. Historically, nickel has mainly been used in the production of industrial alloys (meaning a combination of two or more metals), mostly to add strength and ductility. The central role of the nickel commodity frontier for capitalist development came especially with Michael Farraday's combination of nickel with iron to create high-strength stainless steel in the mid-1800s, which was used in construction but also increasingly for guns, ammunition and vehicles, with nickel-fortified steel armor used in warships during the mid- to late-1800s (Howard-White, 1964). From the mid-20th Century, the nickel commodity frontier expanded significantly as the use of steel, and newer lightweight alloys, became instrumental for the production of, *inter alia*, aircrafts and armaments (Voskoboynik & Farrugia, 2022 and see Figure 1).

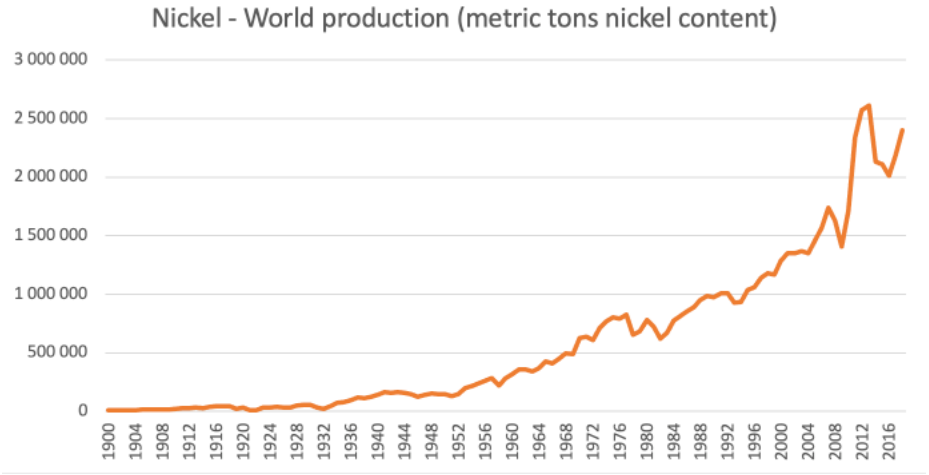

Figure 1: Nickel world production 1900-2018. Source: US Geological Survey, Nickel – Historical statistics (2018) https://www.usgs.gov/media/files/nickel-historical-statistics-data-series-140

Where through most of the twentieth century it was stainless steel that drove the nickel commodity frontier, today the production of lithium-ion battery cathodes, particularly for EVs, is increasingly driving demand, and hence profits for mining companies. In 2021, EVs accounted for 7% of nickel demand, but IEA (2021, 2022) projections suggest that this will expand rapidly in the coming years with batteries under their so-called "Sustainable Development Scenario" taking over as the largest use of nickel by 2040.[6]

Underpinning this expected demand for batteries are a range of trade and industrial policies that actively seek to shape and direct the geography of the nickel commodity frontier. In 2022, the USA's President Biden adopted the Inflation Reduction Act (IRA), while in 2023 the EU Commission released its Critical Raw Materials Act. A key element of both of these is an attempt to relocate extraction and production processes within home countries (onshoring) or alternatively relocating into territories of geopolitical allies (friendshoring). The IRA specifically targets EVs that have battery components made or assembled "by a foreign entity of concern." Any vehicle that does have relations to foreign entities of concern are not eligible for the law's tax credit of up to US$ 7,500. Similarly, the EU's Critical Raw Materials Act follows up on the long-running aims of the Raw Materials Initiative (2008) to ensure access to reserves outside the EU (through trade, investment and development policies), developing supply of raw materials within EU countries and boosting resource efficiency and recycling (EU Commission, 2008; and see also Riofrancos, 2023).

[6] As discussed by Bridge & Faigen (2022, p. 3), the evolution of lithium-ion batteries technology – as driven by the interests of the automotive sector – is a variable here. Chinese EV automotive-makers have shifted towards so-called LFP batteries – requiring less nickel and cobalt – whether and how Western automotive-makers follow suit is still an open question (S&P 2024).

In conjunction with these policies, nickel was added to the USA's 2022 Critical Minerals List and battery-grade nickel (see below) was similarly added to the EU's 5th Critical Raw Materials list (USGS, 2023; EC, 2023). Through these different policies then, the USA and EU are actively trying to reshape the nickel commodity frontier directly through the production side within their[7] territories, and indirectly in other state's territories through exchange relations. All of this is situated with increasing geopolitical tensions, to more or less explicitly circumvent Chinese involvement and bolster "local" capitals (see e.g. statement by EU Commissioner Breton (2022)).

As a result, S&P forecast in 2022 that "[t]he outlook for nickel prices remains rosy due to an anticipated increase in demand for batteries used in the electrification of transportation" (S&P, 2022: 11). In 2022, this outlook was whetting the appetites of investors and mining companies towards the nickel commodity frontier. As Glencore's head of nickel trading put it in the fall of that year, "investor interest in the nickel-space is huge!"[8] However, as is characteristic of the mining industry's boom-bust cycles, a significant price-squeeze happened in 2023 due to a 30% expansion of production in Indonesia (Dempsey *et al*. 2024). This flooding of the nickel market from Indonesia's low-grade ores led to a 45% fall in the global price of nickel through 2023. Nickel miners in Indonesia now account for 55% of the global market share – outcompeting many of their peers seeking to extract elsewhere in the nickel commodity frontier (S&P, 2024a; Dempsey *et al*., 2024).

Consequently, two years down the line, the position of investors has changed markedly, as noted by a nickel markets analyst at Wood Mackenzie "[t]his is not a good time to be promoting or asking for money for a nickel project – financiers don't like where nickel prices are headed" (quoted in S&P, 2024a). This is a structural change to profitability of immense significance to existing accumulation strategies of those mining companies that are producing outside of Indonesia, which has shaken up winners and losers within the commodity frontier.

Key for this rise of the Indonesian "exporting zone" of the commodity frontier was technological developments around the processing of nickel, making it possible to profitably refine Indonesia's low-grade ore into battery-grade nickel used in EV batteries. Prior to this, it was otherwise only the higher quality nickel ores in Australia, Canada and Russia that were amenable to profitable refining into battery-grade nickel. As noted by an S&P report (2023a), this technological development in Indonesia "suddenly makes [Indonesia's lower quality] reserves relevant." This speaks to how the ecological surpluses required to expand commodity frontiers are never just 'there', they are "revealed by the combination of science, technology and capital at particular historical moments" (Baglioni & Campling, 2017, p. 2443).

Beyond this technological development, it was also the active role of the Indonesian state in managing and mediating its nickel ore for capital through its export ban of raw nickel ore: since the promulgation of this export ban in 2020, companies (predominantly Chinese) have invested US$30 billion in combined mining and refining projects (S&P, 2023a). The dramatic expansion in production over the past year and the subsequent flooding of the market is due to these investments coming to fruition. In response, as we discuss in more detail in the next section, states in control of competing 'exporting zones' in the nickel commodity frontier, such as Australia and New Caledonia, are in turn taking initiatives to economically support and protect their national nickel mining capitals as well as arguing that their higher quality and purportedly less pollution-intensive mining processes deserve a "green premium" in the market.

Despite this recent flooding of the market and drop in prices, for nickel to reach the longer-term demand-projections, current production is far from enough (IEA, 2022). Consequently, market analysts "maintain our expectations for the [nickel] price to stay at historically elevated levels" (S&P, 2023b, p. 5). Miners, investors and auto-manufacturers are therefore, from their different positions in the nickel commodity frontier, grappling with how to continue accumulating. The next section turns to how one company, BHP has sought to navigate this treacherous nickel commodity frontier.

[7] Of course, member state territories in the EU context.

[8] Glencore rep. in Raw Material Focus: Nickel panel at FTMS, 21/10/22: https://mining.live.ft.com/agenda/session/897684

4. BHP's (failing?) strategies in the nickel commodity frontier

In the 1980s, in the context of the broader internationalization of production, BHP transitioned from being commonly known as "the Big Australian" to becoming a truly transnational company (Parker *et al.*, 2018). In January 2022 the company formally returned to its Australian roots by doing away with its dual company structure on both the Australian Securities Exchange (ASE) and the London Stock Exchange (LSE) to become listed simply as BHP on the ASE. This move was part of a long-run reshaping of the corporate structure that BHP argues has made it "more agile and efficient" in order to "better capitalize on the megatrends shaping our world" – especially the megatrend of a "rapidly decarbonizing global economy" (BHP, 2022, pp. 15, 43). The attempt at capitalizing on decarbonization is particularly evident in how the company is seeking to change the role of nickel in its asset portfolio: by the end of this decade, "around half of BHP's revenue [should be] derived from the future facing commodities of copper, potash and nickel" (BHP, 2021, p. 5). As an illustrative case of mining company strategies around transition minerals, in this section we explore how nickel has gone from a marginal asset to a central one in the company's current accumulation strategies over the past decade. We show how despite these efforts as of yet the company is not significantly accumulating, due to the above-noted technological and market dynamics in the nickel commodity frontier.

Decarbonization as a strategy for expanding the nickel commodity frontier

BHP had a previous stint in seeking to accumulate through expansion of the nickel commodity frontier when it responded to the commodity price boom in the early 2000s by acquiring nickel producer WMC Resources in 2005, which at the time was one of the world's largest nickel miners (Marsh, 2005). The takeover yielded BHP several nickel sulphide mines along with a concentrator, smelter and refinery all in Western Australia, which the company named its Nickel West asset (BHP, 2005a; see Figure 2). This provided BHP with "additional premium long-term options to satisfy continuing demand growth in China and other high-growth economies", reflecting the main demand for nickel at the time being stainless steel (BHP, 2005b). In the slipstream of the Great Recession of 2008, with associated deflated commodity prices and profit-rates, the company went through a period of trying to sell Nickel West (BHP Billiton, 2009; Jamasmie, 2012; ABC News, 2012). Failing to do so, Nickel West was kept, but downgraded within the company to being a non-core asset (PerthNow, 2014; Jamasmie, 2017).

By 2018, however, with an eye towards the opportunities arising under green extractivism, the role of nickel within the company began to slowly change. The 2018 Annual Report gives the first invocation of the possibilities of shifting nickel output towards batteries: "Demand growth has been broad-based, coming from both stainless and non-stainless applications. Nickel use in batteries, while relatively small at present, has garnered much attention" (BHP, 2018, p. 93). Attesting to this changed view of nickel within the company, in October 2018, the company received approval from Western Australia to develop a new nickel mine to feed into its "Nickel West battery chemicals business" (Reuters, 2018). The explicit change of position of nickel in the company came in May 2019 with the CEO now having reversed their position on the potential of nickel: "developments such as climate change and dramatic shifts in technology present both challenges and opportunities" and reportedly saying that Nickel West "offered the potential for high returns because of the expected growth in battery markets and the relative scarcity of quality nickel sulphide supply" (quoted in Reuters, 2019a). The changed position of the Nickel West operations was subsequently confirmed in the 2019 Annual Report: "Nickel West will be retained in the BHP portfolio" (BHP, 2019, p. 70). As we show in the next sections, this is more than a discursive exercise and plays out materially through BHP's efforts to expand the nickel commodity frontier along with improving its position within the nickel commodity frontier through the corporate strategies of takeovers and linking up with new buyers.

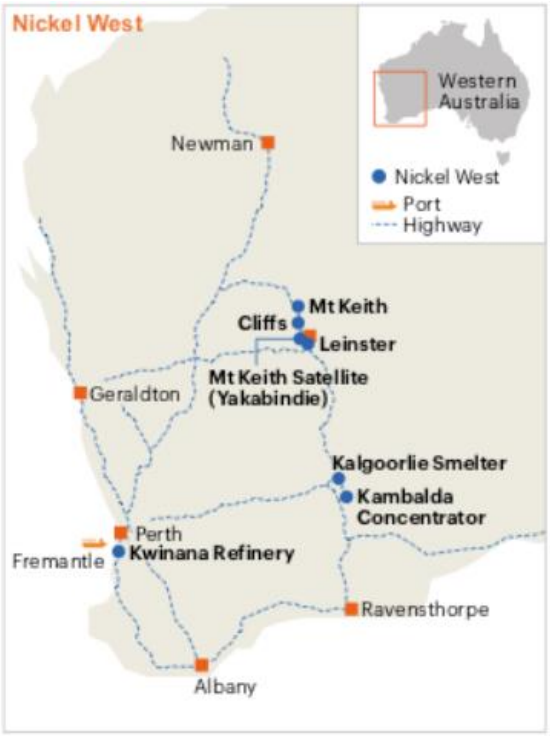

Figure 2: Nickel West as mapped by BHP (2022, p. 25)

Expansion through commodity widening

In a significant move towards bringing in new geographic spaces, in the same year, the company boosted its nickel reserves by 77% and secured a further 13,000-kilometer exploration area in Western Australia with nickel now considered part of the company's core business – particularly due to nickel's role in electric vehicles (Reuters, 2019b). As noted by the company's Asset President: "The electrification of transport is certainly shaping our long-run view of nickel as an attractive commodity" albeit "[w]e do not expect to see a meaningful impact on the nickel market from batteries until the mid-late 2020s" (quoted in *ibid*).

From here, the company began aggressively pursuing commodity widening by significantly ramping up exploration across Western Australia for its Nickel West operations through the "addition of nickel to the exploration portfolio" (BHP, 2020, p. 24). Since 2019 then, nickel has become part of the company's key means of benefitting from the megatrend of decarbonization: "where increasing demand and our capability give us competitive opportunities" (BHP, 2020: 8; and see generally BHP 2019, 2020, 2021, 2022). In the Nickel West operations this involved gradual expansion in extraction, bringing on new mines (BHP, 2020, p. 84): "The Nickel West resource transition involving the construction of three new mines continued to progress during FY2020, with two of these mines now in full production." Consequently, by 2021 the Nickel West operations collectively were the second largest nickel mine in the world with the BHP Nickel West president noting that "[w]e have positioned ourselves to become a globally significant supplier to the battery sector and laying the foundations to create a sustainable business of scale" (Mining 2021; quote from Reuters, 2021).

The strategy was further consolidated in 2022 with the company's highest annual spending on exploration in Nickel West and as noted in that year's annual report: "We continue to explore ways to increase the scale of Nickel West" (Reuters, 2022; quote from BHP, 2022, p. 15). BHP's exploration budget for nickel is grouped together with potash in the Annual Reports, so it's not possible to disaggregate the data. However, Figure 3 shows

quarterly expenditure on exploration for nickel and cobalt in Western Australia since 2000, which gives an indication of the changing position of nickel over the time period above. This includes other companies than BHP, but BHP is by far the most dominant actor in terms of scale of production and investment in Western Australia (Jamasmie, 2021). In 2023, according to S&P (2023c) figures, BHP globally was only surpassed by Vale SA – one of its competitors in Indonesia – in terms of the nickel exploration budget.

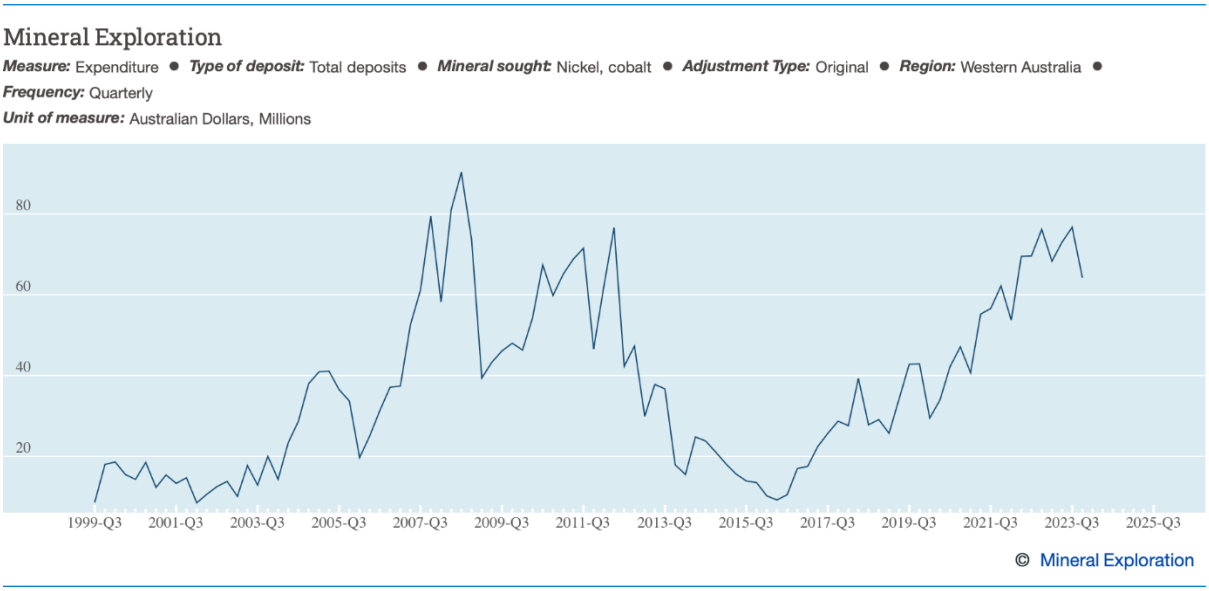

Figure 3: Quarterly expenditure on nickel and cobalt exploration in Western Australia 2000-2023. Source: Australian Bureau of Statistics

As part of this commodity widening, BHP became heavily engaged in developing new technologies to go deeper underground.[9] As noted in the company's 2021 Annual Report (BHP, 2021, p. 28): "Technology collaboration and research partnerships are key to our metals exploration strategy. In particular, we are focused on developing and deploying technologies that will allow us to get to the 'Next 400' (that is below the first 400 metres of the Earth's surface)." To that end, in March 2021 the company partnered with the Canadian Ideon Technologies and in September 2021 signed an exploration deal with KoBold Metals – to develop exploration in these "next 400." The CEO of Ideon explains on the company website that: "[m]ost of the near-surface deposits have already been discovered and that's causing the industry to search deeper underground in more difficult to get to places to find new deposits … That's where we come in."[10] KoBold is a Silicon Valley-based exploration company backed by the likes of Bill Gates and Jeff Bezos, which aims to design, invent and deploy computing technology that can predict compositional anomalies within the earth's crust (Kobold Metals, 2022). Where discoveries of minerals in the previous half century have been detectable at the earth's surface, their technology allows for exploring the "300 to 1500-meter window that has [remained] largely unexplored" potentially allowing for "tremendous discoveries."[11]

[9] As clarified by Moore (2011, p. 37), the geographical expansion that commodity widening "comprises both horizontal and vertical movements."

[10] Video with CEO on company website: https://ideon.ai

[11] Kobold rep., Tech in mining panel at FTMS, 08/10/21.

These new technologies of extraction attest to how for BHP and all other mining companies "the development and adoption of technology is the arms race" in the war that is "the struggle for profit growth and market share" (Shaikh, 2016, p. 15). Constantly being ahead in this arms race is particularly necessary in the context of generally falling rates of exploration effectiveness, with the industry now spending three times more to make 60% fewer discoveries compared to the 1990s.[12]

BHP's commodity widening is therefore challenged through a combination of an overall fall in exploration effectiveness, along with increased environmental and social requirements around new projects. This leads to longer timeframes for bringing on new mines. As summed up by BHP's CEO,

> Deposits are becoming harder to find, often times lower grade [and] deeper. There are more issues that need to be addressed in terms of water management, community engagement [and] broader environmental permitting. So, these things are taking longer, they're more complex, oftentimes they require more by way of financial wherewithal to develop and they're requiring more capability.[13]

Corporate strategies

When challenges such as these emerge around the expansion of commodity frontiers, the competitive dynamics amongst firms that depend on them for accumulation are heightened, necessitating corporate strategies (following Campling, 2012). These inter-firm struggles play out through both control of existing sites of production as well as the "tug of war" in the market over the distribution of benefits.[14] Concretely, we examine two corporate strategies concerning: horizontal relations through acquisitions of other mining sites, and vertical relations to end-users through supply agreements with auto-manufacturers.

As discussed above, BHP's first significant move into the nickel commodity frontier in 2005 happened with the acquisition of WMC Resources. This strategy is now being deployed more aggressively to profit from green extractivism in Western Australia as well as in other geographies of the nickel commodity frontier. BHP's more aggressive pursuit reflects a general increase in mergers and acquisitions in nickel across the industry (Sanderson, 2021).[15]

In 2020, BHP took over Norilsk Nickel's greenfield tenements in Western Australia. These lands were in the northern Goldfields region of Western Australia near to BHP's existing Nickel West complex (BHP, 2020b). In this manner, Norilsk's nickel tenements were subsumed into BHP's existing Nickel West site with the acquired area according to the head of BHP's nickel unit containing "a large prospective amount" of high-grade nickel sulphide resources (BHP, 2020; quote from Fildes & Hume, 2022).

Outside of Australia, in 2021 a US$350 million bid was made for the Canadian Noront Resources, which is developing a high-grade nickel project in Ontario, Canada. This would have given BHP access to "a highly prospective nickel basin in an attractive region" (BHP, 2021b), but the company eventually lost out in a bidding war with the rival Australian mining company Wyloo – despite BHP raising its initial offer (BHP, 2021c). Consequently, by December 2021, BHP accepted defeat, withdrawing and announcing it would not match the proposal given by Wyloo (BHP, 2021d).

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[12] Richard Schodde from MinEx Consulting – Presentation given at the International Mining and Resource Conference, 30th October 2019, Melbourne, Australia, available here: https://minexconsulting.com/wp-content/uploads/2019/12/IMARC-Presentation-27-Oct-2019-FINAL.pdf

[13] Opening Keynote panel at FTMS, 21/10/22, https://mining2022.live.ft.com/agenda/session/897673

[14] Struggles over control of production are discussed by Marx (1990, p. 777) in terms of "centralization proper" entailing the "expropriation of capitalist by capitalist" and rather than expansion of production merely involves a "change in the distribution of already available and functioning capital." The second struggle around "tug of war" in the marketplace references the dynamics discussed by Marx (1992, p. 207) around realization and distribution of value where it "is businessmen who face each other" seeking to "get the better of the other."

[15] As well as for transition minerals more generally, see PWC (2023).

In January 2022, BHP had more success in buying into a nickel project in Tanzania through its US$100 million investment into the UK miner Kabanga Nickel. This project "is regarded as the world's largest development-ready, high-grade nickel sulphide deposit" and the BHP investment into both extraction and refining stages, coming over several tranches, will eventually give it an 18% stake in the project (Hume, 2022). This move back to the African continent, after having otherwise sold its last African asset in 2019, reflects an increased willingness on the part of the company to make investments in what BHP CEO, Mike Henry, has termed "tougher jurisdictions", i.e. outside of OECD-countries, which are considered high risk (Hume & Sanderson, 2021b).

Most recently, seeking to take advantage of the drop in commodity prices in the spring of 2022, BHP in August announced an "unsolicited" bid of US$5.8 billion for the Australian OZ Minerals (Fildes & Hume, 2022). OZ Minerals is developing a site in Western Australia for nickel (and copper) production and the acquisition would therefore further add to BHP's operations in the region. OZ Minerals reportedly sought a sale price of US$6.7 billion. BHP initially rejected this, but subsequently came back with an offer of US$6.5 billion, with the deal eventually going through at US$6.4 billion making it the largest buyout in Australian mining sector since 2011 in the context of the previous boom in commodities prices (Reuters, 2022b). CEO Mike Henry claimed, after the first rejection from OZ, that "BHP's strategy is not dependent on mergers and acquisitions." However, these examples show that acquisitions are a serious component of BHP's corporate strategy regarding nickel (quoted in Reuters, 2022c).

The second component of corporate strategy that BHP is pursuing is through vertical relations with auto-manufacturers. This seeks to better position BHP within the nickel commodity frontier by shifting away from the historical market of stainless steel towards the battery supply chain. Indeed, by the end of the fiscal year of 2019, the Nickel West operation was "selling more than 70 per cent of its production to this sector [battery materials market]" (BHP, 2019, p. 70). Since then, BHP has gone into a number of supply agreements directly with individual auto- and battery manufacturers: with Tesla in July 2021, Toyota Motors and Panasonic in October 2021 and with Ford Motor Company in July 2022 (BHP, 2022b). By the end of the 2022 fiscal year, "87 per cent of BHP's battery-suitable nickel was sold to global battery material suppliers" (BHP, 2022, p. 44).

While BHP cooperates with these auto-manufacturers, it is simultaneously in conflict with them concerning the distribution of value. The "battery-suitable nickel" mentioned in the BHP annual report includes the nickel products of briquettes, powder and nickel sulphate. Nickel sulphate, however, due to a higher degree of processing allows BHP to capture a higher price from the vehicle-manufacturers than it can for briquettes and powder (Jamasmie, 2021c). Consequently, as part of the shift in strategy in 2019 the company has been developing refinery capacities to produce nickel sulphate crystals, which in October 2021 led to its first deliveries through its Kwinana plant (see Figure 2, above). These will "be exported to global battery markets from the Port of Fremantle" (BHP, 2021e) – herein to Tesla's Gigafactory in Shanghai via one of the many dry-bulk carriers that traverse the route from Fremantle to Shanghai (Mining, 2021b).

The company is also in competition with other miners over this relationship with vehicle manufacturers. This plays out particularly with reference to differing environmental and social implications of their nickel production (i.e. the materiality of their reserves) in the broader context of heightened geopolitical tensions. Different locations and types of production processes are therefore used by mining companies to variously appeal to auto-manufacturers' attempt to de-carbonize their supply chains and in some cases to create entirely new supply chains that circumvent Chinese involvement. In this struggle, BHP's nickel sulphide reserves in Western Australia potentially give it a competitive edge over, for example, the nickel limonite reserves in Indonesia, which are of a lower ore quality, and many of which are coal-fire powered and involve Chinese ownership (Maulia, 2022). In this manner, BHP has sought to actively mobilize the materiality of its nickel sulphide reserves. In 2021, prior to the new refining technologies developed in Indonesia, it could claim that its Nickel West operations of

> …nickel sulphides will be particularly attractive. This is due to their relatively lower cost of production of battery-suitable class-1 nickel than for laterites, and the favorable position of integrated sulphide operations on the emission intensity curve" (BHP, 2021, p. 68).

Amid the new wave of production in Indonesia, this claim has in the last year become somewhat doubtful. The point about the role of coal in production along with the dominance of Chinese actors in the Indonesian supply chains remain, however.

Whether and how these become an issue for auto-manufacturers is still an open question, but market analysts increasingly argue that a price premium for nickel "sustainably produced" (which can be flexibly defined) outside of Indonesia will emerge over nickel from Indonesia.[16] This trend is being fueled by the USA's Inflation Reduction Act and the EU's proposed legislation around allowing only batteries with carbon footprint declarations to be sold within its internal market (Sanderson, 2021). In the context of the current price squeeze, the Australian Resources Minister is actively trying to persuade EU-counterparts to favor sourcing of material from Australia with reference to the need for a "green premium" on Australian nickel along with how – hinting to the EU's WTO-case against the Indonesian government for its export ban on nickel ore – "We're a reliable supplier of commodities that are not subject to undue interference or restraint from anyone, but particularly the government" (quoted in Greber, 2024).

Attesting to state exchange-side attempts at shaping of commodity frontiers and companies positioning themselves around that, just a few years ago there seemed to be more interest by various buyers in those mining projects or possible mining projects where it is clear that they will conform with the new and emerging EU- and US-policies –those like BHP's Nickel West operations.[17] As BHP's chief of nickel operations put it in 2022, "Australian companies are well placed to be a partner of choice, recognizing … Australia is a favored jurisdiction from which to source commodities" (quoted in Reuters, 2022c). Since the IRA has been adopted US-based firms – "from mining to automobiles" – were reportedly seeking to link up with Australian nickel miners (*ibid*). Again, in the context of the price-squeeze, this is sought furthered by Australian miners being repurposed as "domestic" in the US through the Defense Production Act, which also gives access to funding for critical mineral projects – including nickel (S&P, 2024; Greber, 2024).

Despite these state efforts at directing the commodity frontier, BHP is feeling the squeeze of their Indonesia-based competitors and the structural transformation of the nickel market, which has at the moment completely undermined BHP's bet on exclusively pursuing the higher-grade nickel ores. As noted by an investor relations manager at Nickel Industries Ltd., "[s]tructurally, a lot of supply is coming out of Indonesia and it's just cheaper … than what can be produced in Australia, Canada or New Caledonia. The surplus is obviously pushing down the nickel price at the moment, and so all of these Western producers [herein BHP] can't make money" (quoted in S&P, 2024a).

Consequently, strategies that have actually bet against these EU- and US-directed efforts seem to be coming out on top. For example, in March 2023 Ford announced plans to invest $US4.5 billion in a nickel plant in Indonesia together with a Chinese miner and BHP's competitor, Vale (Dempsey *et al.*, 2023). In any case, for auto-manufacturers, the imperative to gain secure sources of supply amid competitive dynamics of accumulation is clear. A representative from General Motors evocatively described this imperative, through the lengths to which they were considering backward integration to secure their supply in order to reach EV sales targets post-2025, including buying into mining companies:

> All bets are off – we are absolutely convinced that this is a race, that it is a bit of a zero-sum game that resources are a finite thing and then when you start to put on the lenses of ESG on it and the best location for these to come from etc. then the pie is very, very small. … there will be losers and there will be winners and we are absolutely determined to be winners. And so … whatever it takes to do that.[18]

[16] Managing director at BMO Capital Markets, *Raw Material Focus: Nickel* panel at FTMS, 21/10/22: https://mining.live.ft.com/agenda/session/897684

[17] Glencore rep., Raw material focus: Nickel panel, FTMS, 21/10/22 https://mining2022.live.ft.com/agenda/session/897684

[18] GM Rep., Director of Purchasing, Electric Vehicle Critical Materials, *Industry Focus: Resourcing the car industry* panel at FTMS, 21/10/22 https://mining2022.live.ft.com/agenda/session/897698

As this suggests, there is intense struggle among vehicle manufacturers reflecting the broader challenge within production to ensure "greater speed, regularity and certainty" of their necessary raw materials in order to avoid any type of interruption in that process (Marx, 1992, p. 219). It is in light of this scramble for supply that BHP's acquisition strategy should be seen, where until recently it was the more high-grade nickel ores that dominated in the production of batteries. In this manner, BHP's different strategies feed into each other, with decisions around exploration, along with acquisitions into what was until recently very strategic nickel sulphide reserves, geared to position the company optimally toward the potential growth market for nickel to supply the automotive industry.

However, this whole strategy hinging on high-quality nickel ore reserves and a price premium for them at time of writing seems to be failing dramatically. Indeed, as noted by a *Bloomberg* story (2024), BHP's efforts at championing nickel as part its accumulation through decarbonization strategy have "turned into a disaster." The disaster has so far culminated in BHP's CEO conceding that the company in the first half of 2024 would have to come to a decision as to whether or not it would have to completely shut-down its Nickel West operations (BHP, 2024). At time of writing, the company has not announced a selling-off but effectively mothballing all production, announcing a "focus on preserving cash, which includes the potential to place Nickel West into a period of care and maintenance" (*ibid*).

Some five years into BHP pivoting towards its apparent decarbonization strategy through nickel, it seems safe to say that at the moment at least, it is a story of failure. Nickel remains insignificant in BHP's overall asset portfolio; by the end of 2023's financial year, its nickel business slid 61% from the previous year (Reuters, 2024). Moreover, in 2021 where BHP was amongst the top-three producers globally (IEA, 2021), today it is lagging far behind the Indonesia-based Chinese competitors. Where BHP today has 2% of global production the Chinese company, Tsingshan Group, which profitably introduced the processing technique for low grade Indonesian nickel ore in 2021, has surged and currently dominates, accounting for 20% of global production (Statista, 2024).

5. Concluding remarks

This article examined mining company accumulation strategies in the midst of green extractivism through the case of BHP in the nickel commodity frontier. We have demonstrated how BHP has sought to, but so far generally failed, to significantly accumulate through the expansion of the nickel commodity frontier. We conceptualized green extractivism as a *moment* of expansion and reconfiguration of the geography of extraction of transition minerals, influenced by states, and potentially offering new profit opportunities for the mining companies involved. As such, in our analytic, commodity frontiers constitute green extractivism, and green extractivism is therefore usefully analyzed through the concrete practices of states, and especially companies, as they navigate in the 'gravitational field' of the profit motive. This shapes where, how and how much mining takes place, i.e. the spatial dynamics of commodity frontiers. Especially in the 'Darwinian' situation of cut-throat competition that characterizes the green extractivism moment, profits are by no means guaranteed with firms "sometimes succeeding, sometimes just surviving and sometimes failing altogether" (Shaikh, 2016, p. 259).

Consequently, *if* green extractivism, as some argue, is usefully understood as "structural (i.e. systematic, intensive, and continuous)", we would contend that its spatiality and the particular practices and strategies of the actors involved in it (winners and losers) need to be carefully examined (Tornel, 2023, p. 6). While it is of course important to grapple with whether and how green extractivism has systemic qualities to it, as well as its role in the present phase of capitalism, such endeavors should not lose sight of how, at least in our reading, it is fundamentally constituted by "the anarchy of individual capitals and their strategies of accumulation" and these are "always contingent on particular conditions – of markets, competition, technical change, and not least the trajectories and outcomes of class and other social/political struggle – which are constantly changing, often as unintended effects of successful or unsuccessful accumulation strategies" (Bernstein & Campling, 2006, p. 434). The political ecology of green extractivism is currently very strong on addressing the element of struggle, but we would argue there is at the moment less focus on questions of markets, competition and technical change and their effects on accumulation strategies. With this contribution, we sought to take a step in that direction.

Beyond the analytical contribution of illuminating dynamics within the nickel commodity frontier and how major mining companies can dramatically fail in their 'bets' on the future, we hope that our analysis and

conceptualization of green extractivism is also politically enabling. In our conceptualization, green extractivism is not a foregone conclusion in that it is made up of the "mundane workings of states and firms" and these routinely fail on their own account in competition with other actors, but if their workings are properly understood those currently succeeding can also be interrupted or even halted by counter-forces (Arboleda, 2020, p. 22).

Identifying potential moments of tension and friction in the functionally integrated supply chains emerging around decarbonization technologies also mean eyeing out opportunities for political intervention beyond the immediate sites of extraction. This, we think, can be helpful for future counter-strategy developments to challenge the successful mining company strategies of accumulation. As noted by David Harvey (2013, p. 86), "[t]he whole system, when we understand it well, appears as both fragile and vulnerable."

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