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How much, what, how and why?

DOES CHINA CONTROL ARCTIC MINERAL RAW MATERIALS?

Patrik Andersson & Per Kalvig

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INTRODUCTION: GETTING 'CONTROL' OVER MINING AND MINERALS RIGHT

China's domestic mineral resources are inadequate to support the demand of the country's industry and infrastructure development. This demand has been generated not only by China's domestic needs. As China has taken on the role as the 'factory of the world', a proportion of resources has in effect been used to manufacture goods for the rest of the world (Woetzel et al., 2019). To ensure long-term supply of the resources China needs, Chinese companies are increasingly engaging in mining and mineral exploration projects overseas (Ericsson et al., 2020), and their interest in the Arctic as a source of mineral raw materials has grown (Andersson et al., 2018).

This pursuit of minerals in the Arctic and elsewhere has given rise to concerns in the West. Fears have ranged from China's enormous demand driving up commodity prices globally to state-backed Chinese companies taking control over mines overseas. This in a bid to strengthen their grip on global supply chains of minerals – in particular the processed, high-quality materials and products that are used for producing renewable energy and communication technologies. Because of their perceived economic importance and associated supply risks – in many cases caused by China's quasi-monopolistic position in their supply chains – these materials are considered 'critical' in countries with advanced manufacturing sectors, such as the United States (US), Europe and Japan (USGS, 2022; EC, 2020). There have also been concerns that Chinese state and private firms behave not only as profit-seeking businesses but also to accomplish the long-term geopolitical projects of the Chinese Communist Party (CCP). This is the case also in the Arctic, where Chinese companies' engagement in Arctic mining and mineral exploration is often viewed through the prism of Arctic geopolitics and China's growing Arctic ambitions (Brady, 2017).

Scholars have disagreed on the impact of China's global quest for primary mineral raw materials. Some have argued that China is seeking to lay claim to resources overseas 'by all means necessary', and, in so doing, is 'changing the world' (Economy and Levi, 2014). Others have argued that Chinese control over mining globally has been exaggerated and is in fact very limited (Ericsson et al., 2020). This paper feeds into this debate by focusing on Chinese interests in Arctic mining and mineral exploration activities. Despite Arctic resource extraction supposedly being an important component of China's goal of becoming a 'Polar Great Power' (Brady, 2017), little is known about the scale and scope of Chinese engagement in the Arctic mineral sector, and how much control Chinese companies actually have over Arctic mineral flows. And while some claim that Chinese firms have 'locked up supplies of strategic minerals and metals overseas through a 'combination of state-directed investment and state-backed capital (FP, 2019), little is known about

the degree to which their activities are actually aligned with Chinese official strategies and policies.

In this working paper, we explore these questions based on analysis of a dataset of mining and mineral exploration projects covering all the major commodities or commodity groups in six Arctic countries or territories – Canada, Greenland, Finland, Sweden, Norway and Alaska. We do so through an approach that moves beyond ownership of mines as a measurement of control. Mine ownership in itself has little significance for where the raw materials go to be processed. Industry demand and supply security hinge more on highly processed materials and advanced products than bulk raw materials. Our approach is instead to assess Chinese control over mineral flows from the Arctic using a comprehensive set of 'control parameters'. Compared to an ownership-based approach, we begin one step further upstream in the supply chain – at mineral exploration – and look one step further downstream, by taking into account control via, for example, offtake agreements or monopoly over processing technology.

We find that Chinese companies are involved in a very small share of Arctic projects overall, that their activities cover a very wide range of commodities, most of which are focused on exploration, and that they are heavily concentrated in Canada. The scale of Chinese involvement might, however, be more extensive than our data shows because many Western miners view Chinese companies as their natural – and first choice – offtake partners. It is thus likely that many companies expect to sell to China but have not entered into a formal offtake agreement, or that we have just not been able to find evidence of such agreements. Our findings also suggest that while Chinese engagement in the Arctic mineral sector has been limited, the investments that have been made appear to support China's mineral strategy relatively well. This is evident from both the range of commodities that are targeted and from variations in degree of control across commodities that are differently prioritised in China's mineral strategy.

Below, we begin by introducing the concept of raw material 'criticality'. We then briefly review debates about the drivers behind China's resource quest in the Arctic and beyond, and the role of supportive state policies in encouraging Chinese companies to invest overseas. We proceed by discussing Chinese plans for the mineral and foreign policy sectors, which is where we find the main policies and incentives that Chinese mining companies respond to. This is followed by a detailed description of our methodology. Finally, we present the results of the analysis, before arriving at our conclusions.

WHAT IS RAW MATERIAL 'CRITICALITY'?

In the past 15 years, the combination of rapidly rising demand for mineral raw materials and their tighter supply has led to growing concerns over supply security. This has triggered renewed interest in raw material 'criticality', defined by Schrijvers et al. (2020: 2) as 'the field of study that evaluates the economic and

technical dependency on a certain material, as well as the probability of supply disruptions, for a defined stakeholder group within a certain time frame'. The focus of criticality debates has shifted since they first emerged in the early years of the Second World War. The new round of debates has centred on the advanced materials and products needed to produce emerging energy and communication technologies, such as lithium, cobalt and rare earth elements (REEs) (Hayes and McCullough, 2018; Jin et al., 2016).

Several countries or regional intergovernmental groupings have launched initiatives to identify which minerals and raw materials are critical for their economies as a whole. The European Commission (EC) published the first list of 'critical raw materials' (CRMs) for the EU in 2010, which has since been updated three times. The most recent list, published in 2020, contains 30 raw materials deemed critical in view of their economic importance and high supply risk (EC, 2020). In 2018, the US Geological Survey released a list of 35 'critical minerals, which it defines as those 'deemed critical to the economic and national security of the United States' (USGS, 2018). A revised and expanded list containing 50 'critical minerals' was published in 2022 (USGS, 2022). The production of these lists involves a wide range of experts from government, industry and academia (Machacek, 2017). Although these lists mainly encompass mineral-forming elements, it is not the minerals or mineral concentrates that are critical, but rather the processed, high-quality materials and products in which these elements are imbedded. It is these materials and products that are in demand by the downstream manufacturing industry.

CHINESE INVESTMENT IN THE ARCTIC AND BEYOND: NEITHER A 'CHINA INC.' NOR 'EVERY SOLDIER FOR HIMSELF'

Much of the research on what drives Chinese investment abroad appears to come from one of two diametrically opposed perspectives. One sees Chinese investments as part of a strategic long-term approach – a 'China Inc.' – and tends to portray Chinese companies as agents sent by the CCP to advance Chinese state interests overseas (e.g., Brady, 2017; FP, 2019; Cáceres and Ear, 2013; Gill and Reilly, 2007). The other perspective sees a fragmented and disorderly situation more akin to 'every soldier for himself' (e.g., Downs, 2014; Jones and Hameiri, 2021). According to this view, Chinese companies are driven primarily by their narrow self-interests, which are often ill-aligned with – or even contrary to – the interests of government agencies and financial institutions. Perspectives on China's quest for Arctic minerals largely mirror those above in that some see Chinese Arctic activities as part of a long-term strategy for the Arctic region (Brady, 2017; Wright, 2018; Scrafton, 2018), while others see fragmentation,

opportunism, and companies competing for state support (Zeuthen, 2017; Têtu and Lasserre, 2017).[1]

Yet if we look past these labels and metaphors which seem to represent opposing views, we find that there is in fact relatively broad agreement in the literature that Chinese companies follow their own business priorities as they advance state objectives, usually by seizing opportunities provided through supportive state policy. Chinese companies are not part of a centrally coordinated state machine, nor are they left to fight on their own without any support or assistance. The CCP does have a complex set of levers which it can use to control companies. The probability of government intervention varies depending on the commodity involved as well as on geopolitical factors. But even if the CCP in principle has the power to directly intervene to secure investments in projects it deems strategically important, the preferred mode of governance is to issue general policies that encourage companies to contribute to state objectives (Andersson, 2021b).

CHINESE PLANS FOR THE RAW MATERIAL AND FOREIGN POLICY SECTORS

Despite having abandoned the command economy in 1978, the Chinese government has continued to issue all kinds of strategic plans for the country's economy and industrial development (Naughton, 2017; Heilmann and Melton, 2013). Today, China has both a national strategy for mineral raw materials and a regional foreign policy strategy for the Arctic. The aim of China's mineral strategy (which covers activities at both the domestic and the international level) is not only to ensure a stable long-term supply of minerals and materials needed for economic growth, national defence and the maintenance of key societal functions, but also to support specific industrial objectives. China's foreign policy strategy aims to advance Chinese political, economic and security interests in different global regions. Both of these strategies are accompanied by a set of political and economic incentives that are designed to support their realisation.

China's mineral strategy and the Chinese catalogue of 'strategic minerals'

China's mineral strategy is outlined in a series of policy and planning documents, trickling down from the general level to the sector-specific level. The broad development guidelines and trends are set by overarching half-decade plans for social and economic development, commonly known as 'five-year plans'. Local governments at different levels also issue their own five-year plans which need to align with the broad guidelines set by the national plans, although they are given some flexibility in choosing how to implement those guidelines. Plans are also

[1] For a more comprehensive review of this debate, see Andersson (2021b: 11-16).

issued for the development of specific industries or sectors, and even individual commodities or commodity groups (Andersson, 2021b).

The key planning documents for the mineral sector include, for example, national and provincial plans for mineral resources as well as commodity-specific plans, such as development plans for the REE sector (MIIT, 2016b) and the non-ferrous metals industry (MIIT, 2016a). Documents outlining major industrial policies such as Made in China 2025 (State Council, 2015), and the different 'strategic emerging industries' development plans are also important as they inform Chinese companies and government agencies about the country's industrial development priorities and the demand for different minerals and raw materials, now and in the near to mid-term future. Together with the laws and regulations that govern activities in the mineral sector, such as the Mineral Resources Law and the Environmental Protection Law, they generate the main political incentives that companies in the mineral sector respond to.

The national mineral resources plans (NMRPs) set the overarching goals of China's mineral sector, including preliminary production targets or quotas for selected minerals (which are confirmed or updated on an annual basis). The most recent plan covered the years from 2016 to 2020.[2] It was drafted mainly by the Ministry of Land and Resources (now the Ministry of Natural Resources), with a leading role for China Geological Survey, and with input from several other ministries. It established China's first official catalogue of 'strategic minerals', which included 24 minerals deemed crucial for 'protect[ing] national economic security, defence security, and the development needs of strategic emerging industries' (State Council, 2016: 14-15).

The catalogue contained mineral resources as diverse as iron, copper, oil, natural gas, uranium, coal, tin, lithium, crystalline graphite, gold and REEs (see Table 1). Compared to lists of 'critical' minerals in, for example, the EU, the US and Japan, the Chinese catalogue takes a much broader scope in that it includes bulk raw materials such as iron ore and copper as well as minerals for which China dominates global supply chains, such as lithium, REEs and tungsten. The latter two are deemed 'strategic' not mainly because of concerns over supply security but precisely because China dominates their supply chains – a dominance that China can leverage to pursue political and economic objectives (see below). Chinese policymakers and researchers have divided the 'strategic minerals' into different subcategories, the most important of which are discussed below.[3]

Strategic staple minerals

Strategic 'staple minerals' (大宗矿产) are minerals and raw materials that China needs in very large quantities for energy security and infrastructure development,

[2] The new national five-year plan for mineral resources will presumably run in parallel with China's fourteenth five-year plan and cover the years from 2021 to 2025. It was expected to be published in late 2021 but has likely been delayed because of the COVID-19 pandemic.

[3] For an in-depth discussion and breakdown of Chinese categories of 'strategic minerals', see Andersson (2020).

for which there is a high supply risk, including iron ore, copper, aluminium, oil and natural gas. Most of the minerals in the Chinese catalogue belong to this category. Although Chinese demand for bulk raw materials such as iron ore and copper will remain high for many years, demand growth for some energy minerals such as coal has already peaked.

Strategic emerging industry (SEI) minerals

Strategic emerging industry minerals (战略性新兴产业矿产) are minerals needed for developing China's so-called 'strategic emerging industries' (SEIs), including lithium, REEs, tungsten, cobalt, tin, molybdenum, antimony and zirconium. The SEIs are a set of nine high-tech industries identified by the Chinese state as crucial long-term drivers of economic growth and investment. The nine SEIs are: next generation information technology (IT), high-end equipment manufacturing, new materials, biotechnology, new-energy vehicles, energy conservation and environmental protection, new energy, the digital creative industry, and related service industries (including standardisation, research and financial services) (Xinhua, 2020). The 'new materials industry', which lists hundreds of materials and products such as lithium battery diaphragms, rare earth permanent ferrite and high-power graphite electrodes, is in itself classified as a SEI, and supply of these materials is deemed crucial for developing several of the other SEIs (National Bureau of Statistics, 2018).

Advantageous minerals

Advantageous minerals (优势矿产) are minerals and materials for which China dominates global supply chains, such as REEs and tungsten (Chen and Wang, 2007; Wang, 2009). To protect and preserve China's resource advantage, their mining and processing are heavily regulated, and foreign investment is either not allowed or heavily restricted. The category of 'advantageous minerals' has been closely interlinked with the quota system: the minerals categorised as advantageous have often been subjected to production quotas rather than production targets (Andersson, 2020). For REEs, quotas for extraction and processing are allocated to four large SOEs. Other Chinese companies can only get access to quotas through cooperation with one of the four companies (Kalvig, 2021). Foreign investment in China's REE industry is not permitted.

Table 1. China's official list of 'strategic minerals'. Source of data: China's National Mineral Resources Plan (2016-2020).

Mineral type	Minerals / raw materials
Energy minerals	Oil, natural gas, shale gas, coal, coalbed methane, uranium
Metallic minerals	Iron, chromium, copper, aluminium, gold, nickel, tungsten, tin, molybdenum, antimony, cobalt, lithium, REEs, zirconium
Non-metallic mineral	Phosphorus, potassium chloride, crystalline graphite, fluorite

China's foreign policy strategy and the mining sector

In the last decade, the Arctic has been integrated into major Chinese foreign policy initiatives. The Arctic is now part of the Belt and Road Initiative (BRI) in the form of a 'Silk Road on Ice' (冰上丝绸之路, officially translated by the Chinese state as 'Polar Silk Road') (SCIO, 2018). Becoming a 'Polar Great Power' (极地强国) is part of the broader goal of becoming a 'Maritime Great Power' (海洋强国) (China Ocean News, 2014). The Chinese state also classifies the polar regions as 'strategic new frontiers' (战略新疆域), together with the deep sea, outer space and cyberspace – spaces where great powers compete over resources and geopolitical influence, where sovereignty is often contested or ambiguous, and where China seeks to (re)shape global rules and standards (Andersson, 2021a). All these initiatives have been accompanied by an increase in state funding. Chinese mining companies – who continue to orient themselves first and foremost by China's industrial development priorities and its demand for different minerals and raw materials – thus have to be increasingly attentive to policies and priorities originating from the foreign policy sector, and the opportunities that these may bring them. The BRI, in particular, has opened possibilities for companies seeking support for investment in marginal projects in regions deemed strategically important, such as the Arctic.

THEORY: SUPPLY CHAIN CONTROL

As noted above, the aim of this paper is to investigate how the implementation of the Chinese strategy for supplying mineral resources to Chinese downstream sectors affects the Arctic mineral industry. Many of the world's most attractive mines are already owned by Western firms and mineral exploration projects are long-term and risky. To guarantee a sufficient supply of resources to Chinese industry now and in the future, the Chinese government has to create conditions whereby Chinese companies are willing to make long-term investments overseas. This could be by, for example, incentivising Chinese firms to acquire projects or companies in Arctic countries, to secure resources via offtake agreements with Western miners, or to help develop Western-owned projects by providing funding or technical assistance. These are examples of activities or engagement which allow for different degrees of control over mineral flows from the Arctic.

What is 'control' and what is being 'controlled'?

To assess Chinese control over mineral flows stemming from Arctic mining and mineral exploration, we need to answer two basic questions: 1) what do we mean by 'control' and 2) *what* is being 'controlled', i.e., 'control' over which minerals and raw materials, and in what part of the supply chain? In other words, what 'control' means and how it is achieved might vary depending on whether we are looking at iron ore, REEs, or some other commodity, and *where* in the supply chain we are looking.

Some studies have focused on Chinese control over upstream mining activities outside of China. Ericsson et al. (2020), for example, assessed Chinese control over mining operations in Africa and globally. Their study relied mainly on ownership of mines as the indicator of control. Based on a methodology which put an ownership share of 10% as the minimum threshold for control, they estimated that Chinese control over African and global mine production was around 7% and 3% respectively. This led them to conclude that 'Chinese companies are far from taking control over African mining and even less so over global mine production' (Ericsson et al., 2020: 179).

However, both studies and political practice have acknowledged that there are ways of controlling mineral flows other than through formal ownership of mines. As noted above, the purpose behind 'criticality assessments', which are carried out by many national governments, is to identify vulnerabilities along different parts of the supply chain. In the EU, for example, they mainly focus on assessing the risk of supply disruption of processed materials and mineral products deemed crucial for EU downstream industries (although criticality assessments have been criticised for being imprecise because they list minerals or raw materials rather than specific supply chain products). Reliance on a single country or provider for supply is considered a risk in such assessments. Criticality assessments may thus reach very different conclusions as to who is in control of mineral supply than a study focused solely on upstream mine production. For example, while Ericsson et al. (2020) found that China only controlled around 3% of global mine production outside of China, criticality assessments, by contrast, often highlight as particularly problematic the heavy reliance on China for supply of mineral raw materials.

We argue that mine ownership in itself has little relevance for what and for whom a mine produces. It is even less relevant for assessing control over downstream processing and manufacturing. From a supply security perspective, a focus on upstream mining activities is arguably misplaced because what governments deem 'critical' is not the minerals or the mineral concentrates – what is extracted at the mining site – but rather the processed, high-quality materials and embedded products that are in demand by the manufacturing industry. Assessments based solely on ownership of mines may lead to policy recommendations that do not address the real bottleneck of the supply chain. They may, for example, put excessive emphasis on new mining activities when what is needed is development of advanced processing technologies.

Studies that focus on ownership of mines may furthermore underestimate Chinese control over supply chains overall. Ownership is not even a good measurement for control over the mine and its production as such. The minerals, regardless of where they are extracted and by whom, must be processed and developed into products downstream that can be readily used by the manufacturing industry. In general, value chains for mineral raw materials involve a complex net of highly specialised and geographically diverse industry groups. Vertical diversification of the value chains is growing, and monopoly over these technologies may come with de facto control over unprocessed mining output. This is because the

alternative would be to rely on inferior or outdated processing technology, which would be deemed too costly or uncompetitive on the global marketplace. If, for example, many Western miners rely on Chinese partners for buying their unprocessed minerals or intermediary products, those partners would likely have a much greater control over the mine than what might be implied by their ownership share in the mine or the company. They will also control supply further downstream, which, as noted above, is often where the bottleneck is. In general, Western miners of 'critical' minerals and raw materials have very few options for customers, as opposed to miners of bulk commodities such as iron ore, copper concentrates, etc.

To fully assess Chinese control over mineral flows from the Arctic, we must therefore look beyond ownership of mines. With an ownership-based approach, a REE project fully owned by a non-Chinese company which has signed an offtake agreement for REE concentrates with a Chinese firm would *not* be considered Chinese-controlled. But in this case, it is obvious that Chinese companies would have a high degree of control over not only the extracted raw materials but over downstream processing as well. For a comprehensive picture, it would be necessary to account for the whole supply chain, as the bottleneck may be found in different places for different commodities. This is, however, beyond the scope of this paper. Our approach is similar to Ericsson et al. (2020) in that we assess Chinese control over mineral flows outside of China by departing from Chinese engagement in projects overseas. However, our study begins one step further upstream: at mineral exploration. Exploration is the first step in the mineral supply chain. Controlling the major exploration projects of the world is the first step towards controlling the mineral supply of the future. We also take one step further downstream than Ericsson et al. (2020) by taking into account control via, for example, offtake agreements or technological assistance, as these are indicators of de facto control over mineral flows.

METHODS: OPERATIONALISATION AND ASSESSMENT OF CONTROL

The approach of this paper is to assess Chinese control over mineral flows from the Arctic using a set of 'control parameters'. Each parameter is given a specific score; these scores are then combined to arrive at an aggregate 'control score'. The higher the score, the higher the degree of control. Our approach is thus based on a theory of control by which each parameter adds an additional layer of control. With our approach, any errors or imprecisions in the scoring on specific parameters will have a smaller impact on the total score than would an approach that combines addition with multiplication of selected parameters.

An approach based on multiple parameters has been deemed too difficult and complicated by some other scholars. Ericsson et al. (2020: 155), for example, argue that it would be 'virtually impossible' to make a quantitative assessment of control over a mine or a mining company. In their study, ownership is thus seen as an imperfect but practical choice. We believe, however, that given the right

combination of parameters and some research time devoted to tracking documentation, a quantitative assessment of control is possible. Even if necessarily imperfectly implemented, such a procedure provides a more relevant and meaningful picture of control than an approach focused solely on mine ownership. Below, we explain the rationale and scoring of each of the parameters that make up the assessment framework. The awarded points are shown within brackets.

1) Chinese partner company type (2, 4, 10)

We have allocated different scores depending on the size of companies, the scale of their activities, and the type of mining or downstream activities they engage in. If several Chinese companies are involved in the same project and they belong to categories that give different scores, we grant the higher of the scores (we apply the same principle to the parameter of Chinese partner government relations below).

a) Artisanal or small-scale miners, mainly private; no Chinese control (0)

Chinese small-scale, artisanal miners have been found to operate in some African countries (Ericsson et al., 2020). They may sell their produce to small companies or traders who bring it to China. However, these actors tend to operate independently without the knowledge of the Chinese government, who struggles to control their activities.

b) Medium scale miners: private or state-owned; all types of mining (2)

Medium-sized Chinese companies are less closely integrated into the supply chains in China than their larger counterparts. Their involvement in Arctic projects may therefore imply a lesser degree of control by Chinese interests.

c) Major scale miners: mainly state-owned; global activities (4)

Large Chinese companies, in particular state-owned companies, tend to be more closely intertwined and aligned with Chinese state interests and the downstream supply chain in China. Involvement of these companies implies a higher degree of Chinese control.

d) Vertical diversification (downstream taking over upstream activities) (10)

Some of the Chinese companies who invest in Arctic projects specialise in downstream processing and manufacturing. Their involvement implies a high degree of Chinese control over not just the mine output but also the supply of the downstream products that are in demand by industry.

In cases where the Chinese partner is an investment firm or wealth fund, we do not award any points for company type. Control via funding is already accounted for in a separate parameter (see parameter no. 8 below).

2) Chinese partner government relations (2, 4, 10)

The degree of Chinese control over Arctic mineral flows varies depending on the relationship between the Chinese companies involved and the Chinese government.

a) None (2)

Some small Chinese companies do not have any meaningful links to the Chinese government. They may even operate illegally without the knowledge or permission of the Chinese state.

b) Links to local government and/or central government (4)

Some companies are nominally private but have strong links to the Chinese government, via, for example, shareholding or overlapping leadership structures. Even when there is no state ownership, the CCP has a complex set of levers which makes it possible to control companies when it wishes to.

c) Mainly state-owned (10)

SOEs are more deeply integrated into the Chinese state and Chinese supply chains, in particular those large SOEs under the supervision of the State-owned Assets Supervision and Administration Commission (SASAC). The involvement of these companies implies a higher degree of control by the Chinese state.

3) License holder (0)

Mineral license laws vary from country to country, but all Arctic countries operate with mineral exploration licenses and mining licenses or leases. When a company has acquired a project, it is often required to set up a local subsidiary which becomes the formal license holder. Holding a license for a mining project, either directly or through a local subsidiary, does not in itself give control over what is extracted at the mine and where the raw material goes to be processed. The license holder may be completely dependent on an external partner bringing in the necessary expertise for developing the project.

4) Owner/shareholder (10)

Shareholding in a company gives influence over corporate action. In our assessment framework, however, full or partial ownership of a project or company does not in itself give control over mineral flows from the Arctic. It needs to be combined with the other parameters for a fuller picture. We do not distinguish between share sizes. While the majority shareholder may have formal power over company decision-making, de facto control may still lie with a smaller investor or external partner, especially if the major shareholder relies on that investor or partner for developing the project, or for access to vital downstream value chains. Small shareholders may be as powerful and influential as the major shareholders.

5) **Joint venture partner (2)**

The establishment of joint ventures is most common during the mineral exploration phase and may be the start of a long-term investment. A joint venture partnership gives a degree of influence but needs to be viewed in the context of the other parameters.

6) **Board member (10)**

Being a large shareholder often comes with the opportunity to nominate a member to the board of directors. This gives an opportunity to influence the business direction and decisions of the company. Allocating staff to serve as board members of another company is also a means of prioritising company resources and indicates engagement – which may lead to additional control.

7) **Management member (4)**

An especially large ownership share may come with not only membership to the board but to the senior management team as well, which provides an additional lever of influence.

8) **Funding/banking (10)**

Funding is the lifeblood of mining and mineral exploration projects. Without funding, projects cannot go ahead. Chinese companies who can provide funding, either by themselves or via Chinese banks, thus have a high degree of influence over projects, especially if there are few or no other funding sources available. Apart from cases where funding can be confirmed, we have counted cases where a Chinese partner has explicitly offered support for finding financial solutions. Having the ability to offer funding or help with access to funding may in itself come with control, even if funding has not yet been provided.

9) **Offtake arrangement (10)**

Depending on the commodity involved, some projects cannot go ahead if there is not an offtake agreement in place beforehand. An offtake agreement gives effective control over the raw materials extracted from the mine, which is to be further refined into the advanced materials and products that industry can use.

10) **Operator/contractor (4)**

Operators or contractors often provide expertise and knowledge to the project or production. This gives a certain degree of control.

11) **Technical assistance (4)**

Owning the property rights and advanced technologies needed in the mining and mineral processing industry may grant a Chinese partner significant influence over what is extracted at the mine. During the exploration phase, Chinese partners can assist with project feasibility studies. During mining and processing, they provide technologies and know-how. It is often difficult to determine whether a Chinese partner has provided technical assistance to a project. Our assessment is

conservative in that we do not give a score in cases where we have been unable to confirm technical assistance. In projects fully owned by Chinese companies where no Arctic partner has been identified, we award scores for technical assistance, funding, and research and development (see below).

12) Research and Development (2)

Research and development (R&D) is often needed during the exploration phase and is mainly related to ore treatment research tests and plant optimisations. The ability to offer such expertise gives a certain degree of control.

13) Memorandum of Understanding, etc. (2)

A Memorandum of Understanding (MoU) is at a minimum an indication of interest and commitment, although it is usually a non-binding document. How much influence it gives depends on its specific content, which is covered under the other indicators in the assessment framework. Apart from MoUs, we have counted other forms of agreement, such as support agreement, framework agreement, investment agreement, etc. Such agreements are more consequential than MoUs and have often been preceded my MoUs.

DATA COLLECTION AND PROCESSING

The analyses are based on publicly available data on mining and mineral exploration licenses in six Arctic countries or territories: Canada, Greenland, Sweden, Norway, Finland and Alaska. Russia is excluded because of difficulties in accessing sufficient and reliable data. The database developed is not considered complete, although we find the data sufficiently robust for making a reliable assessment of the Chinese footprints in the sectors. For Sweden, Norway and Greenland, we found or requested and received data spreadsheets from government sources with information about licenses which we then built upon. Projects with Chinese involvement in the past 15 years (2007-2022) are included in the survey, which allows us to follow developments across two rounds of mineral resources planning in China.[4] Using a 15-year timeframe means that for a few cases we are able to identify Chinese involvement in a project at some point in the past 15 years but are unable to confirm whether the Chinese company is still involved or not. We accept that our method is imperfect for providing a precise assessment of how much control Chinese companies have over Arctic mineral flows at a specific moment in time. It is, however, highly useful for identifying and comparing differences in control across different commodities and commodity groups, across countries and project types, and for examining the influence of

[4] The most recent national plan for mineral resources covered the five years of China's thirteenth five-year plan from 2016 to 2020 (State Council, 2016), and the plan before it covered the eight years from 2008 to 2015 (State Council, 2008).

China's resource and foreign policy strategies on the activities of Chinese companies.

We count as 'Arctic projects' any projects located within the borders of the selected countries or territories.[5] For Finland, Canada and Alaska, we had to develop the data sets from the ground up. Once we had compiled the data sheets, we carried out an initial round of data processing, in which we began to identify projects with confirmed or suspected Chinese involvement. These were later examined more closely in a second round. In some cases, Chinese involvement was immediately obvious, for example, where Chinese companies owned or co-owned projects. In others, Chinese engagement was confirmed by searching through company materials, such as annual reports, investor presentations and company websites. We then selected those projects where we could confirm Chinese involvement on at least one of the parameters discussed above. For two Arctic projects, we found that the project owner had partnered with a Chinese company for a project elsewhere in the world, but the source did not reveal whether the partnership also concerned the Arctic project. We found it likely that the partnerships extended also to the Arctic projects and therefore counted them as having Chinese involvement. To facilitate the identification of patterns, the commodities were divided into the following commodity groups: 'base metals' (copper, lead, zinc), 'battery raw materials' (cobalt, graphite, lithium, manganese, nickel), 'gemstones' (diamonds, ruby, sapphire, etc.), 'industrial minerals' (barium, borax, calcium, feldspar, potassium, silicon, sodium), 'precious metals' (gold, silver, platinum group metals, PGMs), 'specialty metals' (beryllium, bismuth, gallium, indium, REEs, strontium, tin, zirconium), 'steel alloy metals' (chrome, iron, molybdenum, nickel, niobium, tantalum, titanium, selenium, tungsten, vanadium), uranium, and 'light metals' (aluminium, magnesium).

We then proceeded by awarding scores on each of the parameters. In cases where we could neither confirm nor disprove Chinese involvement on a parameter, we did not award any points. Hence, our scoring is conservative in that it may underestimate Chinese control over some projects. Scoring is furthermore not a precise science, and it often came down to a judgement call by the authors, in particular when scoring for Chinese company type and government relations. As to the reliability of our findings, we have aimed to be transparent about our methodology and data. It serves as an invitation to scholarly debate about the relevance of our parameters and the quality of our data with a view to perfect both our theoretical concept of control and our empirical assessment in later publications.[6]

When the scoring was completed, we were able to study variations in control across different commodities and commodity groups. We could also compare

[5] We considered only including projects within the Arctic circle. However, this would have excluded a large number of projects which are generally considered as Arctic projects, such as those in southern Greenland and many of those in the Canadian north. Indeed, projects do not necessarily have to be located within the Arctic circle to play a role in China's Arctic strategy.

[6] A spreadsheet containing our data and scoring has been published as an appendix alongside this working paper.

Chinese approaches for engaging in projects involving different commodities or commodity groups and compare data across different countries and project types (exploration or mining).

FINDINGS: CHINESE INVOLVEMENT IN THE ARCTIC MINERALS SECTOR

The analysis reveals a number of patterns and trends, the most important of which are presented below.

Engagement in small share of projects overall

We identify Chinese engagement in 43 projects out of a total of 1,736 licenses in the six Arctic countries or territories. While 43 projects represent a miniscule share of all the licenses in the region (about 2%), it would be misleading to conclude from this that Chinese engagement is negligible because i) a significant proportion of the 1,736 licenses are either inactive or concern projects that are not economically attractive and therefore not of interest to Chinese companies; and ii) there are cases where a single project covers multiple licenses which are all held by the same company. Furthermore, the observed 2% of involvement is a conservative estimate because, as noted above, we have only included projects where Chinese involvement could be confirmed.

Engagement concentrated in Canada, focused on exploration

Of the 43 projects, there are 14 mining projects, 11 advanced exploration projects, and 18 prospecting or other early stages of exploration. The higher share of exploration projects is to be expected because globally there are many more exploration projects than there are mining projects.

Thirty-four of the 43 projects are located in Canada. Of the remaining nine projects, four are in Greenland, three in Alaska, and one each in Finland and Norway. We have not found Chinese involvement in any projects in Sweden. While 43 projects make up only a miniscule share of all the mining and mineral exploration projects in the selected Arctic countries, the 34 projects in Canada account for a significant number of the major projects in that country. This raises the question as to why Chinese companies prefer Canada over the other Arctic countries. Is it because of the license system? Is it the geological conditions on the ground? Or does Canada attract Chinese companies with favourable investment policies?

Table 2. No. of projects with involvement of Chinese companies in six Arctic countries or territories. Source: authors' research.

Commodity group	Scandinavia	Greenland	Canada	Alaska	Total
Base metal		1	5	2	8
Battery raw materials		1	10		11
Industrial minerals	1		1		2
Precious metals	1		4	1	6
Specialty metals (REE)		1	2		3
Steel (iron ore/alloys)		1	8		9
Uranium			4		4
	2	**4**	**34**	**3**	**43**

Control varies across commodities

The strongest Chinese control is in the commodity groups of steel metals, base metals and battery raw materials. Steel metals, in particular, stand out as highly controlled. Not much focus has been given to these raw materials in Western literature, despite the fact that iron ore is of vital importance to China's industry and infrastructure development, and thus a key concern for China's long-term mineral resources planning. Of major importance is, for example, the high-volume demand for iron ore for steel production. Of the nine projects where we have detected Chinese involvement, the control score ranges from 72 to 28 points, with an average score of 60 points. The projects most tightly controlled are the Attikamagen (Joyce Lake), Sunny Lake and Duncan Lake iron ore exploration projects in Canada, all owned by Century Iron Mines, a subsidiary of Hong Kong-based Century Global Commodities Corporation. Century Global has strong ties to the Chinese state via Wuhan Iron and Steel Corporation (WISCO) (since 2016 merged with steel producer Baosteel Group) and China Minmetals Corporation, who together hold almost 30% of the shares in the company. Control over the projects is ensured via, for example, shareholding, offtake agreements and funding.

Base metals, mainly copper and zinc, come in second, with an average score of 44 points across eight projects. The Wolverine zinc, copper and lead project in Canada, until 2019 owned by Yukon Zinc Corp., a subsidiary of Jinduicheng Molybdenum Group Co. Ltd., receives the highest control score at 70 points[7]. Interestingly, we could identify Chinese involvement in only three specialty metals projects, all advanced REE exploration projects: the Kvanefjeld project in Greenland, and the Clay-Howells and Wicheeda projects in Canada. This is surprising given China's dominant role in the supply chain of REEs, in particular in downstream processing. The reasons for this could be several: i) that we failed

[7] In November 2018, Yukon Zinc was sold to the Canadian company Phoenix Global Investment Inc. who took over ownership and operations of the Wolverine mine (Croft, 2019). It is unclear whether there is currently any Chinese involvement in this project.

to locate information about partnerships or that plans for partnerships with Chinese companies have not been made public (given recent threats in the Chinese state media of China weaponising its control over REEs, some Western companies may prefer not to promote their Chinese partnerships); (ii) that many REE exploration projects have not progressed to a stage where Chinese partners become involved; (iii) that Chinese companies prefer to engage in projects elsewhere in the world; or (iv) – what we find most likely – that Chinese companies who are involved in the downstream REE supply chains do not find it important to get involved in upstream operations, given that a monopolistic structure of the downstream value chains is already in place, and they are working in a buyer's market. Some projects could also be part of genuine attempts at contributing to 'China-free' supply chains,[8] even if such supply chains are not realistic in the short term.

Uranium is the second least controlled commodity. Chinese control over Arctic uranium projects is mainly achieved via offtake arrangements. One project stands out as more tightly controlled by Chinese state interests – the Patterson Lake South (PLS) project, also known as the Triple R Deposit. The PLS project involves multiple Chinese state-linked partners who hold a high degree of control over the project and its output via not only offtake agreements but also shareholding and board membership in the project's license holder Fission Uranium Corp.

Finally, the weakest control is in precious metals. We found six projects with Chinese involvement, all of which focused on gold. Of these, three were mining projects and three were advanced exploration projects.[9] The lesser degree of control over gold projects is not surprising even though gold is considered a 'strategic' commodity in China (see below). Gold operations tend to be less complex and smaller in scale, and downstream supply chains are fairly simple and widespread, so there is not the same need to have control over downstream activities. It is also not difficult to find buyers for gold. For this commodity, the most common form of control is via funding or shareholding. With the exception of one project that concerned both gold and silver (the Brucejack project in Canada), the precious metals group only includes gold projects.

[8] Some companies have begun promoting their projects as independent from the Chinese supply chains. See, for example, Cheetah Resources' Nechalacho project (The Canadian Press, 2022) and Tanbreez' Kringlerne/Killavaat Alannguat project (Dempsey, 2019).

[9] Four additional gold projects in Sweden and Finland were initially part of our analysis, but we later decided to exclude them. The projects are owned and operated by local subsidiaries of Dragon Mining Ltd. – an Australian-based company listed on the Hong Kong stock exchange. Dragon Mining also operates a number of production centres in the two Nordic countries. However, because this company is based in Australia and because we were unable to confirm Chinese involvement on any of the other parameters, we have excluded those projects from our findings.

Table 3. Variations in Chinese companies' control over mining and mineral explorations projects targeting different commodities in Canada, Greenland, Norway, Finland, Sweden and Alaska. Source: authors' research.

Commodity group	Projects	Score range	Score average
Steel (iron ore/alloys)	9	72-28	60
Base metals	8	70-22	44
Battery raw materials	11	64-20	43
Industrial minerals	2	74-4	N/A[10]
Specialty metals (REEs)	3	56-26	38
Uranium	4	60-26	36
Precious metals	6	50-14	27

No single Chinese company dominates

Our findings suggest that Chinese activities in the Arctic mineral sector are not monopolised by one or a few major companies. We identified a total of 33 medium or large-sized Chinese companies involved in the 43 projects. Some of the projects involve more than one Chinese company. The companies include major SASAC-administered SOEs such as China Minmetals Corporation and WISCO as well as nominally private companies with strong state links such as Contemporary Amperex Technology Co. Inc. (CATL) – the world's largest battery manufacturer. Given their size, we expect that all identified companies have at least some degree of connection to the Chinese state,[11] although the degree to which their activities are shaped by state interests will vary. We have not found any Chinese small-scale miners to be active in the Arctic. This could be because Arctic projects generally require larger investments than projects in other parts of the world due to the unique logistical and technical challenges. Companies need to either have their own capital or enjoy prioritised access to state funds, which smaller Chinese companies tend to lack.

Chinese companies rarely own projects

Chinese companies actually own projects in only 12 of our 43 cases, either directly or through a controlling share in a license holder. We can think of two possible explanations: i) that Chinese companies do not find it necessary to own projects because they can secure resources as partners; and ii) that Chinese ownership over mines is more politically sensitive in the Arctic than elsewhere. As China's

[10] We only found two industrial mineral projects with Chinese involvement and therefore found the average score to be irrelevant.

[11] As noted above, apart from state ownership, the CCP has many levers for controlling Chinese companies, even if the preferred method is to incentivise companies to contribute to state objectives. For example, managers of large private or public companies are often CCP members. Since 2018, Chinese and foreign companies registered on a Chinese stock exchange are required to host party cells, although most large Chinese companies had already established such cells before it became mandatory (Doyon, 2021). With the exception of smaller companies – a company needs to have at least three CCP members to establish a party cell – private unlisted companies increasingly also host party cells. These party cells have become increasingly involved in corporate decision-making in recent years (Blanchette, 2020).

relations with the Arctic countries (excluding Russia) grow evermore strained, this type of arrangement may be preferable for both the Western owner and the Chinese partner: the owner can highlight to investors how the Chinese partner provides technical expertise, funding, market access, etc., while maintaining that it is not a 'Chinese' project. The Chinese partner can maintain de facto control while attracting less political attention than if it was fully Chinese-owned.

CONCLUSION: HOW MUCH CHINESE CONTROL, OVER WHAT, HOW AND WHY?

While Chinese engagement in the Arctic mineral sector has been limited overall, the investments that have been made appear to align relatively well with China's mineral strategy. This can be seen from both the range of commodities that are targeted and from variations in control across commodities that are differently prioritised in China's mineral strategy. This does not mean that Chinese companies are being explicitly directed by the central government to invest in specific projects, nor does it mean that their activities are not profit-driven. But it does suggest that the government has had some success in creating the conditions whereby Chinese companies are willing to make long-term investments in the resources that government planners have identified as 'strategic' for China – either by using domestic laws and regulations to 'push' companies to secure resources overseas, or by using softer measures such as economic and political incentives. Below, we will discuss some of the key observations:

i. The Chinese investments cover a very wide range of commodities, nearly all of which are among those classified as 'strategic' by the Chinese state, including iron, copper, lithium, nickel, REEs, graphite, uranium and gold. The only notable exception seems to be the five zinc projects. Zinc, while essential for Chinese industry, is not included in China's official catalogue of 'strategic minerals'.

ii. Base metals and steel metals are the most frequently targeted commodity groups by Chinese companies. This is consistent with the strong focus on these commodity groups in China's catalogue of 'strategic minerals'. As Western debates about supply security become increasingly focused on the minerals deemed 'critical' for the 'green transition', it is easy to forget about the central role that major commodities such as iron ore and copper continue to play in China's mineral strategy.

iii. The strongest Chinese control is found in steel metals, which is expected considering that several of the metallic minerals in China's catalogue of 'strategic minerals' are used in steel alloys, such as iron, nickel, chromium and molybdenum. Although the catalogue does not seem to rank the 24 'strategic minerals', it was likely intentional that iron is listed first among the metallic minerals. China needs large quantities of high-quality iron ore

to make steel for infrastructure development. Because its domestic reserves are of low quality, it relies on imports to meet the huge demand. China is the world's largest importer of iron ore, accounting for around 70% of the world's total, most of which it imports from Australia (Uren, 2021).

iv. The Chinese state categorises gold and uranium as 'strategic' resources, in contrast to Western ideas of these commodities.[12] State interest could explain the relatively high share of gold and uranium projects and the involvement of large SASAC-administered SOEs in some of them. Both of China's two major nuclear power companies – China National Nuclear Corporation and China General Nuclear Power Group (formerly China Guangdong Nuclear Power Group) – have invested in Canadian uranium projects. In China, uranium has traditionally been considered 'strategic' for military purposes but is now needed primarily for civilian energy purposes. Air pollution caused by coal consumption has become a major threat to political stability in China. Chinese planners regard nuclear power as a cleaner alternative to coal. Apart from helping improve air quality, nuclear power could help China fulfil its global climate commitments by significantly reducing carbon emissions. China's nuclear power capacity is expanding rapidly, with reports suggesting plans for 150 new reactors before the year 2035 (Murtaugh and Chia, 2021). As for gold, some analysts have proposed that China is stockpiling the resource in order to diversify its foreign exchange reserves, which consist predominately of US dollars (Sanderson, 2019). The NMRP (2016-2020) set the preliminary annual production target for gold at 550 tons per year (State Council, 2016: 11).

v. The influence of foreign policy considerations is likely to vary between different projects. It would be virtually impossible to accurately assess the relative influence of geostrategic incentive and resource need in different cases. Even when on the surface it looks as if foreign policy priorities have played a key role, that might not have been the case. For example, some of those who raised concerns over Shandong Gold's bid to acquire TMAC Resources, the owner of the Hope Bay gold mine in the Canadian Arctic, read the project as an attempt by the Chinese state to gain a foothold in the Arctic for its 'Polar Silk Road' (Montgomery, 2020). However, As noted above, the Chinese state categorises gold as a 'strategic' resource, which suggests that incentives generated by state interest in the resource itself may have played an important role for the company as well. We might assume that the influence of foreign policy considerations has been the strongest in cases where four criteria are met: i) where the investment is located in a region that the Chinese state deems strategically important (which includes

[12] Uranium was included on the list of 35 'critical minerals' published by the US Geological Survey in 2018 (USGS, 2018), but it was removed in the updated and expanded list of 50 'critical minerals' that was released in 2022.

the Arctic), ii) where the state does not have a strong strategic interest in the resource itself, iii) where the project's economic case is relatively weak, and iv) where there are plenty of projects to choose from elsewhere in the world with a stronger economic rationale. In cases that fit these criteria, companies may engage in projects in the hope of securing economic and political support from the government for advancing foreign policy priorities, such as the BRI. In cases where the resource is deemed 'strategic' by the Chinese state, companies may still enrol foreign policy priorities as arguments for engagement, as this might further improve their chances of receiving state funding.

vi. Finally, the Chinese quota system that regulates the domestic mining and processing of REEs has incentivised some companies without access to quotas to secure REE resources overseas through partnerships with Western miners. From a central planning perspective, this has encouraged the outsourcing of the upper parts of the supply chain. It is a way of conserving domestic reserves and moving some of the pollution of REE mining overseas while ensuring that Chinese industry gets the REE resources it needs. Shenghe Resources – the investor in the Kvanefjeld project – has stated that the domestic quota restrictions forced it to turn overseas to secure the REE resources it needs for its downstream businesses (Li, 2017). However, as we were only able to identify Chinese involvement in two other REE projects, we can only conclude that Chinese companies' contributions to this strategy have been very limited in the Arctic.

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