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The role of social factors in feasibility decisions for complex orebodies: Exploring early exploration practices of the mining industry in Greenland.

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ABSTRACT

Mining companies have traditionally emphasized factors related to geology, metallurgy, logistics, and the economy when screening the attractiveness of greenfield projects. In recent years, however, there has been a development towards more social awareness and responsibility in the extractive industries, potentially allowing social impacts to play an increasing role in decision-making processes related to greenfield project development. This paper presents an investigation of greenfield screening processes in Greenland and how social factors are considered and influence decision-making. Based on a survey among the mining companies active in Greenland and qualitative interviews with industry and societal players, the study identified a list of factors considered when screening greenfields and found that the dominant focus is still predominantly on geological and mining technology factors. Social and environmental factors are also considered but are less decisive. The study further indicated systematic differences between junior and senior companies in the screening process. The study provides knowledge of the drivers and barriers for the inclusion of social impacts in screening practices which provides valuable knowledge for policy makers on how to create a regulatory push for especially junior companies that have the less extensive screening practices.

1. Introduction

Minerals are essential components of the green transition. The shift to a CO2-neutral energy system is set to drive a significant increase in the demand for certain minerals, such as rare earth metals, lithium, nickel, cobalt, manganese, and graphite (IEA, 2022). Over the next two decades, the demand is expected to increase by more than 40% for copper and rare earth elements, 60–70% for nickel, and cobalt, and almost 90% for lithium (ibid). Access to mineral resources is therefore a strategic concern for government institutions in order to deliver according to global climate agreements. The latest EU Commission assessment of critical raw materials for the Union (European Commission, 2020) shows that the European Union is ultimately dependent on China, which is providing 98% of the European supply of rare earth metals. Reducing dependency on Chinese minerals by securing access to mineral resources is therefore a central element in the Commission's agenda. Most recently, it has resulted in a new European Critical Raw Materials Act (Breton, 2022). Rising demand (together with resource depletion of more accessible deposits) has led mining companies to expand their exploration activities into new and less-explored regions, such as the Arctic, with vast, underdeveloped deposits (USGS, 2022).

Efforts are required in a wide range of areas to achieve a sustainable production of minerals for the green transition (Graedel et al., 2015). Today, mining companies are known to undertake substantial investigations related to early screening when evaluating the attractiveness of greenfield projects and subsequently deciding on whether to submit applications for exploration licenses (Barakos and Mischo, 2021). One point of action that would further sustainable mining would be to evaluate (screen) new potential mining areas in the prefeasibility phase, even before exploration starts, to determine where a community would gain the greatest benefits and pay the least costs when planning new projects while at the same time considering a wide range of other factors, including environmental impact, quality of resources, and availability (Aaen et al., 2021; Harper et al., 2015).

Recent studies, such as Barakos and Mischo (2021), have investigated how early evaluations of deposits are conducted and how they inform the design of mining operations as knowledge about deposits evolves. They find that many prefeasibility studies are focused on a proposed project design rather than addressing alternatives, which could potentially lead to the mitigation of negative impacts. Technical

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consultants have also been found to be reluctant to spend time and money to reconsider the mining and processing methods, infrastructure designs, and overall size of the operation, even when social concerns arise related to the chosen methods and potential environmental impacts of the project (Bullock, 2011). Similarly, other research has found that social concerns are generally addressed late in the evaluation process (Vivoda and Kemp, 2019; Bullock, 2011; Mackenzie and Cusworth, 2007). And that because of the late screening for social factors, towards the end of the final feasibility reporting, aspects of the mining plan are not optimized to accommodate the negative impacts. Therefore, major last-minute adjustments are made to the operation plan at a late stage. Such adjustments are found to lack sufficient analysis and accuracy, which damages the credibility of the entire project (Bullock, 2011). The outcomes that are most often identified as miscalculated include the capital and operating costs, the recovered ore grade, and the time needed for the project build-up. Furthermore, they generally underestimate environmental and socio-political impacts (McCarthy, 2014; Bullock, 2011). As argued by Lèbre et al., 2022 in this special issue, the mining industry does not understand or handle the complexity of the currently available deposits particularly well nor is it the case for the more complex orebodies made relevant by rising demands and ore depletion e.g., in the Arctic.

Greenland is among the Arctic nations experiencing increasing investor- and industry interest, as it is known to be rich in rare-earth metals (Hansen and Johnstone, 2019). However, many of the orebodies in Greenland are complex (Lèbre et al., 2022). They are often found in inaccessible areas, in rough environments with little to no existing infrastructure. The sites are most often sparsely populated and yet of significant cultural and economic value to local communities. Moreover, the mining projects in Greenland are all located on indigenous lands. According to Owen et al. (2022), the intersectionality between the location of critical minerals for the green transition and Indigenous people's lands creates a pressure on Indigenous people's rights over their lands. Owen et al. (2022) argues that the 'land connectedness' of the people and non-industrialized character of the lands along with the minority status of many Indigenous peoples render landscape interactions complex and, therefore, social impacts from mining particularly problematic in these areas. Inuit is not a minority in Greenland. However, the land connectedness of the people and non-industrialized character of the land adds to the complexity of the ores in the country, which underscores the relevance of investigating how social and environmental impacts are handled in early exploration. In addition to local risks regarding social conflicts, human rights violations, biodiversity loss, water depletion and other forms of pollution, large CO2 emissions from energy-intensive mining and refining technologies are also a risk if sustainable mining practices are not ensured (IEA, 2022).

This article presents a study of the existing practice related to the early screening of greenfield projects in Greenland. It contributes to the literature on complex orebodies by showing via a contextualized study the role of ESG factors (with special attention to the social aspects) in the early screening practices. Furthermore, it aims to understand why performances on especially social factors are still not satisfactory by uncovering the barriers for the implementation into early screening practices as well as opportunities for improvements. The article explores the following questions:

1) What do the mining companies do formally and informally when screening greenfields prior to mine site selection in Greenland?
2) What are the most decisive factors in decision-making processes?
3) What are the related opportunities and barriers when screening for social factors?

The following sections present the state of the art in relation to decisive factors for feasibility decisions followed by the overall conceptual framework and methodology used for the study. The results are then examined in section four, main findings discussed in section five, and the concluding comments are provided in section six.

2. Literature review

Screening processes have been investigated by scholars, such as McCarthy (2014) and Bullock (2011). They found that screening reports are often conducted by consultants on behalf of mining companies. Historically, the focus of the early evaluation processes (screening) has been on the geological and geotechnical evaluation of an orebody; only if it was proven economically viable (following the exploration phase) would an attempt then be made to assess the social, environmental, and other nontechnical risks of the potential mining project.

However, attention has increasingly turned towards the importance of gaining a social license to operate and more and more societal stakeholders now expect mining actors to contribute to the local communities they are operating in (Moffat and Zhang, 2014). Scholars such as Kamenopoulos and Agioutantis (2021) and Kamenopoulos and Tsoutsos (2015) have found that risks connected to lack of social licence to operate is one of the reasons for company failure because they create opposition, delays and in the end investor uncertainty. Investors thus call for social licence to operate-risks to be a central part of the feasibility considerations. Recent studies have found that more careful and detailed assessments are required, where the erroneous practices are eliminated, and the actual boundary conditions of the raw materials market and mining industry are considered. Among these conditions are environmental, social, and governance concerns (ESG), which in turn determine whether the social licence to operate can be gained and maintained. This has led to a call for tools capable of promoting socially responsible and sustainable mining (Aaen et al., 2021; Barakos and Mischo, 2021). Tools that can assess also complex orebodies.

ESG factors have received increasing corporate and academic attention in this regard. They are increasingly presented as key explanatory factors for mining-related conflicts (Aaen et al., 2021; Glasson, 2018; Franks et al., 2014). Scholars therefore argue that it will not be the depletion of resources that will eventually restrain mining production but rather ESG factors and related conflicts (Kamenopoulos and Agioutantis, 2021; Jowitt et al., 2020). In discussions related to complex orebodies, ESG risks therefore play a central role in contributing to the complexity - if not defining it alone (Lèbre et al., 2019; Valenta et al., 2019). Adding to the growing importance of ESG factors, lenders worldwide (through the Equator Principles), the World Bank (by way of the IFC Environmental and Social Performance Standards), and corporate players (e.g., the ICCM) have included ESG factors in their policies and lending requirements (Equator Principles Association, 2020; Jowitt et al., 2020; IFC, 2012). Despite increasing attention, the mining industry is however, still underperforming in the implementation of ESG factors (Unep, 2020; Bhrrc, 2020).

Some explanation for this might be found in the fact that regulatory requirements on ESG factors do not cover the early exploration phase. It is therefore up to the individual company to consider which screening factors they find relevant when deciding where to initiate new projects, and there is a lack of knowledge about the applied screening factors and requirements for evaluation in the early exploration phases (Al-Bakri et al., 2023).

Studies indicate that the size of the mining company can be a decisive factor when explaining the role of ESG factors in screening practices. Dougherty (2013) has investigated the differences in conduct between junior and senior companies when it comes to mining practices in general - including the screening phase. He suggests that a shift from mid-tier companies to junior companies has played a role in increasing resistance from local communities, because they underperform on environmental and social dimensions of mining compared to senior companies. Junior companies are found to be less oriented towards international guidelines (Everett and Gilboy, 2003), have less competencies related to ESG factors (Bebbington, 2010) and generally be less

motivated towards performing well on the ESG factors (Marshall, 2001; Bridge, 2004). Everett and Gilboy (2003) explain the differences between junior and senior performance by the fact that junior companies are financed by less demanding investors when it comes to the ESG factors. Rees (2009) finds it decisive that the junior companies only explore the resource to sell it to senior companies leaving them free to pay less attention to building a relationship to local communities and motivated to neglect the social and environmental impacts.

The contribution of this study is therefore not to add to the understanding of orebody complexity but rather to explore how companies are handling the increased complexity and especially how attention towards ESG risks in early screenings can be improved. There is a need for more knowledge about the reasoning behind both junior and senior company conduct in early screenings and the barriers for better implementation.

3. Methodology

To answer our research questions, the factors that were taken into consideration by mining companies in Greenland when screening greenfields in the prefeasibility stage were explored. Based on a mixed methods approach, we first identified and conceptualised relevant categories of screening factors. The categories were then included in a questionnaire distributed digitally to mining companies. The results of the survey were used to inform and inspire an interview guide designed for semi-structured interviews, which was consequently conducted with central stakeholders during field studies in Greenland in the fall of 2022. The interviews served to elaborate and further nuance our understanding of the screening procedures and the use of screening factors. The study focused on mining companies that were active license holders in Greenland in 2022. The methods used are further described in the following.

3.1. Conceptualising screening and screening factors

Although there are different types of extractive projects and different regulatory regimes, mining projects generally tend to undergo similar formal project development phases, including scoping, early exploration (screening), exploration, construction, operations, closure, and post-closure (Hansen et al., 2016) (see Table 1). Each phase leads to decisions by mining companies as to whether to continue their activities and move to the next phase and by the government as to whether to approve a license application or not.

Following our research questions, the focus of the study was on the second phase in decision-making when greenfields are screened. According to the Oxford English Dictionary (n.d.), screening involves '*the evaluation or investigation of something as part of a methodical survey, to assess suitability for a particular role or purpose*'. Accordingly, greenfield screening is understood as; *the evaluation of a greenfield based on the investigation of factors that may influence its attractiveness from a commercial perspective before a decision is made regarding the application for an exploration license.* As mentioned above, screening is the second step in the decision-making process and leads to a go/no-go decision in relation to pursuing an exploration license for a greenfield. The pre-feasibility study taking place in the screening phase approximates the technical and economic viability of a greenfield project focusing on identifying the main challenges, risks, and essential requirements of a successful development (Al-Bakri et al., 2023, JORC, 2012). The content, relevant factors, and degree of accuracy can vary between projects and companies.

The study focuses on the screening phase - as opposed to the scoping phase that lies prior to it, because some level of information related to mining design is needed to assess the social impacts. Conversely, the pre-feasibility studies taking place in the screening phase, are less accurate compared to the feasibility studies in the exploration phase. This means that more design alternatives are open in the screening phase compared to the exploration phase making it more relevant to screen for social impacts because more opportunities are open for adjusting the project in ways that could mitigate potential social impacts.

Table 1
Overview of phases in mining projects and related investigations and decisions in Greenland based on review of key documents (e.g., the Mineral Resource Act, available feasibility reports, and current impact benefit practices) as well as guidance documents (e.g., IGF, 2020).

	Evaluation activities	Decision by end of phase
Scoping	Evaluation of greenfield attractiveness according to factors chosen by company.	Whether or not to continue to prefeasibility phase.
Early exploration (screening)	Prefeasibility studies. Initial field surveys according to factors chosen by company.	Whether or not to continue to feasibility phase. Application/no application for exclusive exploration licence.
Exploration	Feasibility studies, social impact assessment, impact benefit agreement, and environmental impact assessment according to legislation and regulatory guidelines. Geological fieldwork (drilling, etc.)	Application/no application for production licence.
Design	Design and planning of the proposed mining project.	Project plan
Construction	Building of mining camps, housing, refining facilities, roads, ports, dams, etc. depending on the design of the respective mine.	
Operation	Extraction, processing, and transporting of the ore.	Application for extension of licence.
Closure	The management of environmental and socioeconomic impacts from mining closure. e.g., rehabilitation of environment	
Post closure	Environmental monitoring	

Before distributing a questionnaire to the mining companies operating in Greenland, we wanted to identify categories of factors that they could be expected to take into consideration during their screening processes while also allowing the respondents to correct and/or add to the list. This list was tested further with the informants. To ensure that the screening factor categories were all considered, we leaned on the work of scholars, such as, Valenta et al. (2019), and van Duuren et al. (2016), who expanded the traditional perception of risk factors to also include ESG factors.

We thus distinguished between conventional screening factors and ESG risk factors. The applied framework therefore includes conventional screening factors together with ESG risk factors. Conventional factors are inspired by indicators used by the Fraser Institute in their annual mining company survey (Yunis and Aliakbari, 2021) to establish the investment attractiveness index; an index measuring the investment attractiveness of nations. The factors in the index focus on regulation, infrastructure, and business conditions (e.g., taxation). Our understanding of the ESG factors follows one commonly used in research related to complex orebodies. Hence, ESG risks are situated in the national and/or local context and is unrelated to company performance (Lèbre et al., 2020). ESG risk factors cover environmental, social, and governance-related matters (Lèbre et al., 2020) and the occurrence of ESG risks can be understood as an indicator of orebody complexity because it complicates impact mitigation. The ESG risk factors definitions build on conceptualizations by Valenta et al. (2019), Lèbre et al. (2020), and Aaen et al. (2021). Definitions of factors are further described in Table 2.

While focusing holistically on the many factors comprising the feasibility process regime, the study pays particular attention to the decisiveness of social factors.

Table 2
Definition of categories of screening factors. Conceptualization is inspired by scholars including Aaen et al. (2021), Yunis and Aliakbari (2021), and Valenta et al. (2019).

Conventional screening categories	
Geological factors	Factors related to properties of the deposit (e.g., volume, homogeneity, purity)
Mining factors	Factors related to the conditions for mining the deposit (e.g, access and extraction costs)
Market conditions	The market value of the mineral and available supply and demand
Logistics	Factors related to transport of the resource, such as distance to market, transportation conditions, and port proximity
Regulations	E.g., requirements for exploration, requirements for extraction, and maturity of regulations
ESG risk categories	
Social factors	Factors related to characteristics of the community (e.g., closeness to communities, vulnerability of communities, conflicts)
Governance factors	Factors related to the political landscape and broader institutional setup of government (e.g., experience with mining, risk of corruption, institutional stability)
Environmental factors	Factors related to the surrounding environment (e.g., vulnerability of environment, the impact on the environment during extraction)

3.2. Data collection

The data collection for the study was based on a mix of a small-sample quantitative survey distributed to exploration companies holding licenses in Greenland during the 2021–2022 period and semi-structured interviews with key Greenlandic civil society-, market- and governance players.

3.2.1. Structured survey

A short survey was distributed to the 82 licence holders in Greenland in September 2022. Of the 82 licence holders, six responded (response rate 7%). Four of the six responding companies were only engaged in exploration (junior companies), while two were undertaking both exploration and extraction (senior companies). One company was newly started, three companies had been in business for 5–10 years, and two had 10–15 years of experience.

The survey consisted of three background questions about the companies, including the number of employees, years of activity in Greenland, and the nature of their activity exploration/extraction. One battery related to decisive factors for go/no-go decisions in feasibility studies, including the screening factors identified in the study. Two further questions asked about their perception of the importance of social factors in this phase of project development. The survey further included two open questions giving the companies the opportunity to identify other relevant factors in addition to the screening factors mentioned in the survey. Due to the low response rate, the survey only served to inform and inspire the interviews, which constituted the main empirical data for the study presented.

3.2.2. Semi-structured interviews

Twelve in-person interviews were conducted in Greenland during a field trip in September 2022. These interviews involved civil society, governance, and market players related to Greenland mineral exploration. The informants were selected based on a stakeholder analysis of the mining industry in Greenland identifying the decisive actors in the exploration phase. Not every decisive actor is included in the study, instead the aim was to include an informant from every stakeholder category. The informants included representatives from the Greenlandic Mineral Resource Authority, a mining company with experience from the Greenlandic context, subcontractors in the exploration sector, interest organizations, scientists, and a municipal official. Interviews lasted approximately 1 h pr. interview. They were conducted in Danish and took place in a chosen location by the informant, typically their office. The interviews elaborated on the findings from the questionnaire and further explored themes related to the practices of exploration companies in the exploration phase and explored the informants' views on decisive factors for go/no-go decisions in prefeasibility studies and the relevance of social aspects in the prefeasibility phase.

4. Results – screening practices in Greenland mineral exploration

With the aim of identifying the most thorough business case to investors, exploration companies investigate a number of factors in the early exploration phase of greenfield projects. The survey indicates that the differences between the decisiveness of the factors are minor. Therefore, a conservative interpretation of the data from the survey is that there is indeed a difference between the two most decisive factors: geological and mining factors, and the remaining factors (market, social, regulatory, governance, logistical, and environmental factors), which are less decisive for the feasibility study.

4.1. Decisive factors in prefeasibility screening

The responses to the survey indicate that, in the context of Greenland, geological and mining factors are the most decisive factors for the conclusions of a prefeasibility study. Geological factors such as the volume of the resource, homogeneity, and purity are decisive for mining project profits, because they determine the amount that can be sold, the price that can be obtained, and the profits available. In other words, they determine the economic feasibility of a greenfield project. Consequently, going into a new geographical region, the first thing exploration companies will do is typically to scope out existing materials, such as existing electromagnetic, magnetic, and radiometric survey data, topographic data, and aerial photos, which hold information about the geology. Geological factors are thus decisive already in the scoping stage of a greenfield project (Interview, mining CEO). This is also why the provision of high-quality geological data to potential exploration companies has a strong focus in the Greenlandic Mineral Strategy (Government of Greenland, 2020, p. 5, interview, government representative).

The responses further indicate that mining technology, is a decisive factor in the prefeasibility study because it heavily influences the extraction costs (interview, mining CEO). Mining factors, however, cannot be determined until geophysics has identified physical properties, such as homogeneity of the ore. Mining technology is thus dependent on geological factors.

In the context of Greenland, geological factors and mining technologies both have the potential to halt projects which explains why they become decisive for feasibility decisions (interview, CEO of mining service company, CEO of mining company). They are therefore investigated early in the exploration process to avoid unwise investments. Concrete mining design decisions, however, will be made at a later point in the process.

4.2. Less decisive factors in feasibility screening

The survey finds factors related to the market, regulations, politics, logistics, and the environment to be slightly less decisive than geology and mining technology factors.

The distribution is further supported by the interviews. Informants explain that it is not until the licence area has been reduced to specific target areas that it becomes meaningful to address potential logistic factors, such as access to rivers or streams as means of transport, water supply, and electricity (interview, CEO of mining service company). Water supply and electricity are rarely accessible in Greenland, but this is not a major obstacle for mining operations, who routinely establish such utilities themselves. Conversely, the transport of bulk material can

be challenging if there is no access to a body of water connected to the sea. This, however, depends entirely on the type of mineral being mined (interview, CEO of mining service company).

Despite not being one of the most decisive factors according to survey respondents, it is relevant to screen market condition continuously - also in the prefeasibility phase. One of the reasons being that technology decisions can be influenced by market conditions. One of the informants describes an example where bulk materials are sent to potential buyers in the exploration phase to investigate potentials and requirements that might influence the refinement process and, consequently, the required technology (interview, mining CEO). Price is another influential market factor that is typically investigated already in the scoping phase. World market fluctuations have the potential to stop both exploration and mining rather abruptly. Examples of this are also present in Greenland.

Contrary to geological factors, where results are mandatorily reported and made public, governance factors are typically informally screened. The informal screening of the governance factors (e.g., political landscape, institutional maturity) is performed during the desktop study prior to the PEA/scoping study. Different indices exist that aid these screenings, including Frasers' 'Investment Attractiveness Index' (Yunis and Aliakbari, 2021), the OECD 'Country Risk Classification' (OECD, 2022), and Transparency International's Corruption Perception Index (Transparency International, 2021). One informant described how a large mining company conducted a screening of Greenland during the latest election and concluded that even though the geological potential was promising, they were reluctant to enter the scoping stage due to debate over whether to allow the mining of uranium (interview, mining CEO). Another informant identified stability as a key factor, even more so than favourable legislation (interview, mining service CEO, CEO of mining company). Therefore, even though Greenlandic legislation can be complex for companies to navigate - with its structure of impact benefit agreements, social- and educational funds, taxation, and royalties, catering to the stability of legislation and the consistent interpretation of regulations are more important than changing regulations to a more favourable regime for exploration companies (interview, mining service CEO). Comments from the survey also mentioned clarity and transparency as key factors for feasibility decisions together with factors relating to the licensing-process bureaucracy. Governance factors are therefore also taken into consideration, but they are less decisive.

Environmental factors are typically investigated in environmental baseline studies related to environmental impact assessments. Exploration companies are keen to start environmental baseline studies early because the environmental impact assessment, which is a prerequisite for an extraction license, requires a 3-year baseline study (interview, mining service CEO). Consequently, the mere indication of a feasible project is enough for an environmental baseline study to start. At the same time, however, exploration companies must limit the licensed area to target areas before environmental baseline studies are possible, because environmental baseline studies are only relevant in specific locations and furthermore difficult and expensive to perform on a regional level (interview, CEO of mining service company). This means that environmental factors are typically addressed 2–3 years into the exploration process. There are, however, examples of companies who commence the environmental baseline study in Year 1 (i.e., in the prefeasibility phase). This occurs when the target minerals are relatively easy to scope compared to more intricate minerals. Hence, the timing of the environmental baseline study depends on the properties of the mineral and specific deposit.

Practices related to environmental factors illustrate the differences in the approaches of junior and senior companies. While many junior companies follow the approach described above, senior companies in Greenland tend to take a more diligent approach regarding environmental impacts (interview, government official). Environmental factors therefore play a far more decisive role in the scoping of the prefeasibility stage of exploration. It means that senior companies are also more attentive regarding the environmental impact of the exploration process itself (interview, government official).

4.3. Screening for social factors

The social factor which was of special interest in this study, is like the environmental factor in the sense that junior companies operating in Greenland typically do not include social factors in the prefeasibility stage. One informant described how regulatory requirements to do so would probably be a deterrent for junior companies to invest in Greenland at all. '*If you start making it difficult for people [companies (ed.)] to get in, they will go elsewhere (…) the money flows to where it's easiest*' (interview, mining CEO). Since exploration in Greenland is currently primarily driven by junior companies, alienating risk-willing venture capital would be problematic for the sector (interview, government official and CEO of mining service company).

The data suggested that the senior companies have a different approach to social factors in exploration when operating in Greenland. In addition to already being attentive to social impacts in the prefeasibility phase, they invest more in maximizing the positive social impacts by focusing on dialogue and cooperation with local communities (interview, mining company CEO). Among other things, this means that senior companies hold community meetings in cooperation with the Greenlandic state and local authorities already in the exploration phase as part of obtaining the social license to operate. Other examples are companies that invest in educating local employees and subcontractors in safety standards or equipment that enables local subcontractors to meet their standards (interview, government official). A representative from one senior company thus stated in the survey that 'the social factors are first and foremost to any exploration company'. While this may be true for this specific company, informants indicate, this not to be the case for all the exploration companies operating in Greenland (interview, government official, CEO mining service company).

4.4. Differences between junior and senior companies

There will be individual variance between companies, but the data indicates a general difference in the exploration practices of junior and senior companies in the Greenland market. Illustrative of the difference is how, contrary to the four junior companies that participating in this survey, one of the senior companies, that answered the questionnaire, noted that the factors were all 'most important' and claiming that, in their view '*all factors (…) have equal importance. If one element is missing then it's likely that your project will not advance through the feasibility stage*' (Comment from survey).

The informants all supported this conclusion, claiming that senior companies generally concern themselves more with their relationship with local communities and societal stakeholders than do junior companies. Social factors are thus more relevant for senior companies to consider as risk factors because they are still involved with the communities when potential negative impacts occur in the extraction phase. In contrast, junior companies are only involved in the exploration phase, after which they typically sell the project to a senior company (Christiansen, 2022).

5. Discussion – drivers and barriers to the screening of social factors in prefeasibility studies

The results from the analysis indicate that social factors play a smaller role in the prefeasibility stage compared to geological and mining factors. The following discusses the drivers and barriers affecting the prioritization of social factors.

5.1. Drivers for the screening of social factors in prefeasibility studies

There are international, national, internal drivers for the inclusion of

social factors in the prefeasibility phase. The internal drivers within the company are typically tied to an interest in reducing the uncertainty in the feasibility study (interview, mining CEO) and ensuring a social license to operate. Feasibility- (and especially prefeasibility studies) are generally characterised by a degree of inaccuracy. In a study of 60 mining projects, Gypton (2002) found that over 50 pct. Of the projects exceeded the predicted costs in the feasibility study by more than 20%. Any element that will increase the accuracy of the feasibility study is therefore welcomed by exploration companies (comments from the survey). Predicting social obstacles plays a part in increasing the accuracy for exploration companies in Greenland and they can also be decisive in terms of predicting 'showstoppers' due to an opposing public. As one respondent explained:

> '*Obstacles should preferably be identified as early as possible. It's expensive and silly to invest and be rejected later because of problems that you could have predicted.*' – Mining CEO

Understanding potential social obstacles in the local area is thus a part of predicting problems that could result in rejection but understanding the social impacts of a project early is also important for obtaining social license to operate. According to representatives from the Mineral Resource Authority, however, this is a greater concern for the senior companies.

Mining companies are also driven to include social factors in prefeasibility studies by demands from international lenders (e.g., the IFC, the European Investment Bank) to uphold certain standards related to environmental and social impact assessments (Equator Principles Association, 2020; Mernitz, 2017). Most of the prominent international investment banks are committed to the Equator Principles – a set of principles governing their lending practices. These principles include an elaborate environmental and social assessment regime. The commitment from lending institutions trickles down to mining companies as loan conditions, which then become a driver for mining companies to assess the environmental and social impacts already in the prefeasibility process.

In addition to lenders, multinational mining corporations typically adhere to regulations originating from outside Greenland because they carry their best practices with them as a way of ensuring consistent practices. An example from Greenland is a company that was adhering to the NI 43–101 (National Instrument 43–101, 2001/2011), which is a Canadian regulation for the standards pertaining to the disclosure for mineral projects within Canada. It stipulates that all mining exploration within Canada must provide a technical report for publication and describes specific requirements regarding the content, including factors such as local resources, ownership structures, and infrastructure, all of which have social components (National instrument 43–101, 2001/2011). This is not a requirement in Greenland. Another example of this is the Australian JORC code (JORC, 2012). Because many of the exploration companies are multinational, national regulations from other nations thus becomes a driver for screening social factors in the prefeasibility stage. This might explain the difference between junior and senior companies in their approach to social factors; junior and senior companies do not have the same ties to other jurisdictions.

5.2. Barriers for the consideration of social factors in screening practices

Greenlandic regulations include very little requirements for companies to consider social factors, and the lack of regulatory push is identified as a barrier to include social factors in the prefeasibility process. The Greenland authorities have the legal basis to include conditions in the licensing agreement (e.g., conditioning a license on screening for social impacts) (Mineral Resource Act, 2009/2020 §16) but have never done so. According to one former government official, they are generally reluctant to include too many requirements in the exploration phase, as easy access is one of the factors that determines the investment attractiveness of a country (Yunis and Aliakbari, 2021). Rather, to promote progress in exploration, the licensing agreements typically focus on requiring progressively increasing investment throughout the license period (Mineral Resource Act, 2009/2020).

In Greenland today, social impacts are primarily assessed in a social impact assessment, which is a requirement for gaining an exploitation license (Mineral Resource Act, 2009/2020). However, one of the survey participants from the mining industry indicates that a social impact assessment falls short of assessing the actual social impacts, because it; '(…) *is not as critical as the environmental impact assessment, as it largely is based on standard interviews, calculations and assumptions that are identical from project to project*' (Comment from survey). That is not to say that the Greenland government does not consider social impacts important in the administration of mineral resources. Guidelines for environmental impact assessment and social impact assessments are in place (Government of Greenland, 2016; Mineral Resources Authority, 2015), and the government has taken pre-emptive measures, as advised by The Committee for Greenlandic Mineral Resources to the Benefit of Society (Rosing et al., 2014), to ensure that no mining will commence in areas with too many negative social consequences. Consequently, 'buffer zones' have been established around settlements and environmentally vulnerable areas (e.g., UNESCO areas).

Apart from the lack of regulatory push, the survey and interviews identify a range of different explanations for the lack of social focus in the feasibility process. One barrier driven by both market conditions and Greenlandic regulatory conditions is an inherent incentive to 'paint the most attractive picture' of a project. It has the consequence that social impacts and dynamics are not scrutinized too carefully, because they have a tendency to identify more risks. This practice is driven by two incentive structures:

1. As indicated by the informants, exploration in Greenland is dominated by junior companies, which are motived to portray a project as positively as possible for the purpose of reselling it.
2. Regulatory push to show a good business case to obtain an exploitation license.

While being valuable in terms of revealing the potential unwanted risks in the project, social impacts studies can be costly. Cost as a barrier is thus identified both in the conducted survey and in other contexts (Barakos and Mischo, 2021; McCarthy, 2014). The balancing of costs and level of detail when screening social impacts thus often favours cost at the expense of thorough screenings which is un accordance with results found by Barakos and Mischo (2021). Furthermore, the survey respondents argue that social impacts are indeed very important in the early exploration phase of a project but that they are difficult to handle due to their complexity. One respondent especially underlined the complexity of balancing social factors at the local, municipal, and national levels. The uncertainty in this early phase means that the complexity is rather substantial, which makes screenings unprecise and the delimitation of investigation difficult. The respondents of the survey therefore argue that social factors are not yet considered relevant this early in the process.

The study contributes to the discussion on mining companies' ESG performance by nuancing the current status (Unep, 2020; Bhrrc, 2020) and showing that there is a difference in ESG performance between junior and senior mining companies. The results from the study are generally in accordance with studies done on the differences between junior and senior mining companies' performance on social factors when trying to explain the differences. This study, e.g., supports explanations identified by Everett and Gilboy (2003) that junior companies have less orientation towards international standards on ESG performance and as a result are less motivated to include ESG factors in assessments as found by Marshall (2001) and Bridge (2004).

When attempting to improve on ESG performance, junior companies is therefore worth some attention for regulators, because social risk and social no-go factors (factors that will result in human rights violations if

not handled correctly) (Aaen et al., 2021) could potentially be identified in the early screening phase when selecting greenfields for development and they are often not because it is often handled by junior companies.

The study furthermore shows the complexity of complex orebodies. It identifies both internal, national, and international drivers for the EGS performance of both junior and senior companies. It thus supports the point made by Lèbre et al. (2020) in that complex orebodies should be understood as complex socio-technical systems where social regimes interact with technical, regulatory, historical, economic, ecological systems as well as many others and not as isolated systems. Due to the scope of the study, the selected informants and the theoretical framework, the study has primarily identified drivers within the economic, regulatory, and technical systems. There is therefore an obvious reason for further research into the drivers that originate from e.g., the social or historical systems which would be valuable input to policies that could contribute to a regulatory push for increased attention on social impacts in early exploration in Greenland and elsewhere.

6. Conclusions

The interaction of the mining industry and the context in which it is developed creates complex ESG risks, particularly in the cases of complex orebodies. While the formal processes which do require consideration of ESG factors, such as applications for exploitation licenses have been subject to various studies, the study presented in this paper aims to provide a more nuanced understanding of the early and informal considerations by mining companies before moving into a new area of complex orebodies.

The study found that the dominant focus of greenfield screening processes in Greenland is on conventional factors; more specifically, on geological and mining technology factors. While ESG factors are also taken into consideration, they are less decisive. The investigation further indicated that there are systematic differences between the conduct of junior and senior companies in the screening process; junior companies are typically interested in selling their license after the exploration phase, and therefore, less interested in the potential impacts in other development phases. In contrast, senior companies are typically guided by a code of conduct or international best practices, as they operate in multiple countries and are used to complying with national legislation, as well as international expectations related to ESG factors.

The study further identified both drivers and barriers to the inclusion of social factors in early exploration. The desire to reduce uncertainty and risk as well as obtain a social license to operate, were two drivers that originated internally in the mining companies. Whereas pressure from international lending institutions and the regulations from the mining companies' country of origin were two external sources of drivers. Likewise, barriers originated both internally and externally to mining companies. A lack of regulatory push and the incentive to paint an attractive picture of the project were two externally driven barriers, whereas the costs and complexities of assessing social impacts were related to the internal processes.

Even though the study found that social factors in the case of Greenland, were not decisive for feasibility decisions, it also doesn't support the narrow narrative that the companies alone act on ESG to appease investors and achieve a social license to operate. Different motivations for including social factors were identified such as reducing uncertainty in the feasibility studies and predicting showstoppers to the benefit of both companies and local communityes. Since the study only covered Greenland, investigations of early screening processes in other countries under different jurisdictions could further strengthen and nuance the understanding of if and how ESG factors are and can be considered by governments and/or mining companies in the earliest phases of decision making prior to new mining activities. This could furthermore be valuable input to how an effective regulatory policy push could be designed.

Author statement

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