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Territories of Contention: The Importance of Project Location in Mining-Related Disputes in Finland from the Geosystem Services Perspective

Toni Eerola

Geological Survey of Finland (GTK), Mineral Economic Solutions Unit, Mineral Intelligence Group, P.O. Box 96, 02151 Espoo, Finland; toni.eerola@gtk.fi

Abstract: Geosystem services produced by geological processes are the abiotic equivalents of ecosystem services. Geosystems also contribute to satisfying human needs and produce welfare in the form of, e.g., mineral deposits, landscapes for recreation and tourism, and habitats for rare species that require protection. Geosystems are inherently linked to ecosystems, which causes overlap between provided services. This overlap may in turn cause conflicts over land-use needs and interests. Such controversies can be manifested as mining and mineral exploration disputes (MMEDs). Six MMEDs from Finland were selected for a closer examination. The MMEDs are described and spatially analyzed from the geosystem services perspective. The main causes for the examined MMEDs are land-use issues, i.e., the location of a project in a sensitive context (a protected area (PA), tourism destination, reindeer herding area, or lake area with vacation homes), and/or association with uranium. There have been attempts to block some of the projects through land-use planning by expanding PAs or excluding mining from the municipality. Conversely, one of the projects is an example of the safeguarding of mineral deposits by province-level land-use planning. A more comprehensive consideration of geosystem services by land-use planning may help to accommodate and reconciliate diverse interests and alleviate disputes.

Keywords: land-use; disputes; geosystem services; mining; mineral exploration; sustainability

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1. Introduction

Due to their formation in special geological circumstances, economically exploitable mineral deposits are not found everywhere but in certain places that need to be discovered. For this reason, on average only 0.01% of mineral exploration projects leads to an important discovery or an actual mine [1–3]). Another challenge is caused by the location dependence of mineral deposits. Mineral exploration should be guided to feasible targets by geological reasoning, and the exploitation of any deposit is only possible when it has been discovered and its extraction is economically feasible. Therefore, mineral deposits, as well as their exploration and exploitation, are attached to places primarily determined by geological processes. The deposits cannot be transferred to other locations, and this differentiates the mining industry from many other extractive sectors.

Mining and mineral exploration are essential to maintain the raw materials supply for society. For instance, access to land is a fundamental prerequisite for mining and mineral exploration to occur. This is usually granted by a permit issued by a mining authority. However, acceptance of the activity by the local community or other stakeholders may also be essential. Often, other land-use forms may overlap with a promising mineral deposit. For example, Ref. [4] concluded that 7% of mines for four key metals directly overlap with protected areas (PAs), and a further 27% lie within 10 km of their boundary. According to [5], most mining areas (82%) target materials needed for renewable energy production, and areas that overlap with PAs and remaining wilderness contain a greater density of mines compared to overlapping mining areas that target other materials. Furthermore, according to [6], 69% of all projects focused on energy transition metals are located on the lands of indigenous people and peasants. In these cases, the interests of the mining industry may diverge from those of the local community and/or non-governmental organizations (NGO). As mining has environmental, social, and economic impacts, land-use conflicts in the industry have been common [7–14].

Refs. [8,11–13] have examined mining-related disputes in Europe. Ref. [15] described mining and mineral exploration disputes (MMEDs) in Finland. According to the data, out of 73 companies holding or applying for mining and mineral exploration permits in Finland in 2020–2021, 17 (23%) were involved in disputes with local communities and/or NGOs. Due to the battery minerals boom, most of the cases are related to mineral exploration, which differs from the EU and global trends, where the majority are related to mine development and production (see [11,16]). Ref. [15] also concluded that most of the disputes had one main root cause, i.e., operation in sensitive contexts (PAs, reindeer herding, lake areas with vacation homes, tourism destinations, indigenous Sámi homeland, and deposits associated with uranium). Uranium has been an issue in the Finnish mining debate since 2006–2008, when the commodity was explored for the last time in Finland [15,17]. Ref. [15] referred to these sensitive contexts prone to MMEDs as "territories of contention". Coincidently, these issues were requested to be considered as no-go zones for mining and mineral exploration in the reform of the Finnish Mining Act. These are issues attached to values, world views, leisure, and the livelihoods of local people, which may be challenged by mining and mineral exploration in such places. In this sense, the project location, and its associated land use, i.e., the operational context, is of crucial importance for the social license to operate (SLO; 15). The SLO means acceptance or approval of activities by a local community and by society (Thomson and Boutilier 2011). Although land-use issues have been one of the fundamental causes of mining conflicts, the importance of project location has not received the attention it deserves in the SLO debate, and emphasis has been given to procedural and distributional fairness [17–21]. Therefore, based on the examination of concrete cases of MMEDs in Finland, Ref. [15] added the importance of place within the query-based Finnish SLO framework developed by [17].

Finland has been one of the top destinations for global mineral exploration and mining investments. As one of the main mining countries of the European Union (EU), Finland has further potential to develop its mineral resources to improve the EU's self-sufficiency in and supply security of mineral raw materials, as well as to contribute to the green energy transition. Therefore, a deeper examination of the land-use issues associated with MMEDs may shed additional light on the spatial pre-requisites for the SLO in Finland. Spatiality is an important tool in investigating disputes and associated social movements, as it helps to understand their causes and dynamics [22]. Therefore, some of the cases examined and described by [15] were selected for closer examination in this study: the Hannukainen iron–copper–gold, Juomasuo gold–cobalt, Rompas–Rajapalot gold–cobalt, Sakatti nickel–copper–PGE, Sokli phosphorite–niobium–rare earth element (REE), and Heinävesi graphite mine and mineral exploration projects (Figure 1). They have previously been studied, for example, by [23–28].

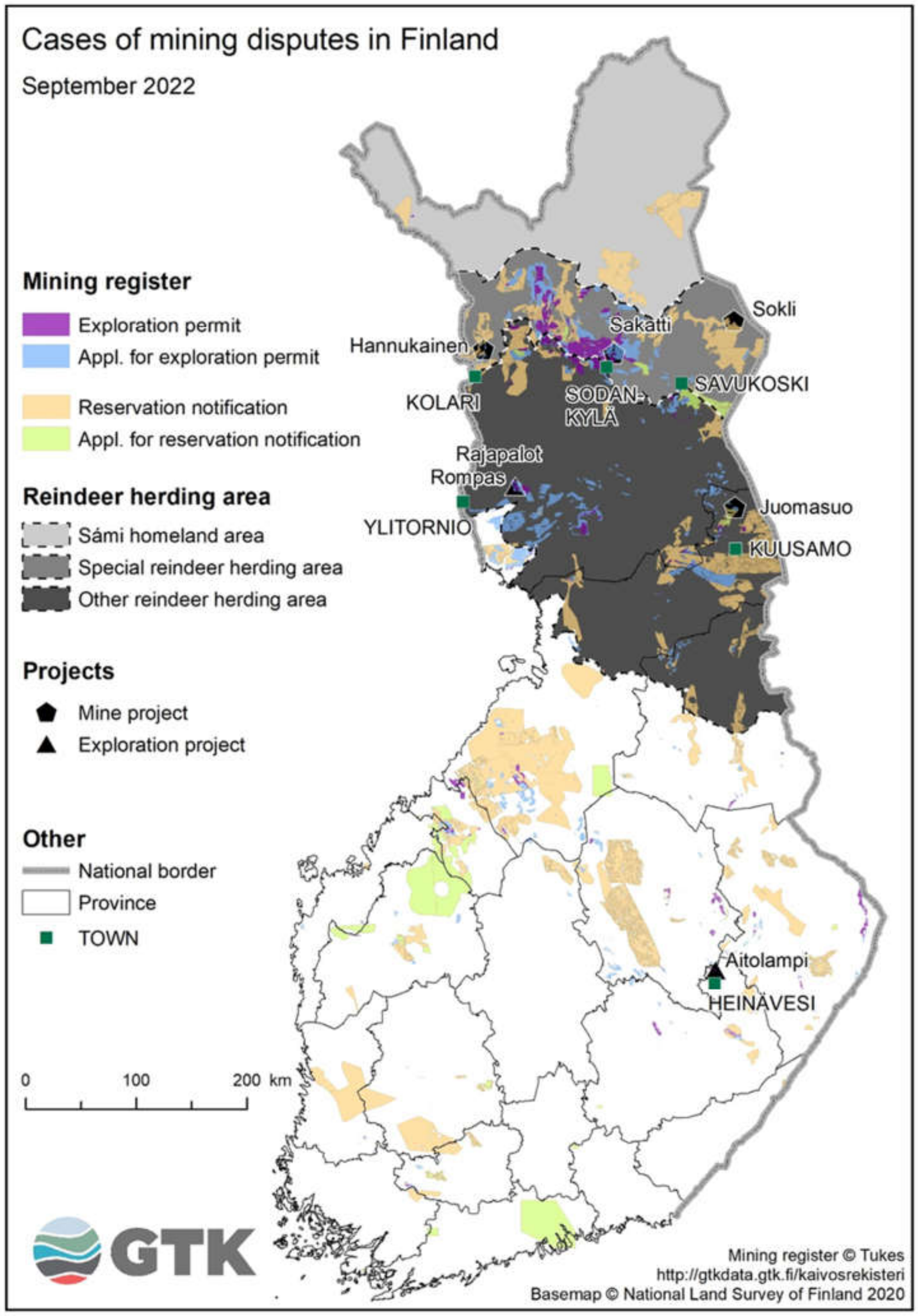

Figure 1. Selected contentious Finnish mining and mineral exploration projects and related localities (after [15]).

These cases are among the most important and advanced mine and mineral exploration projects in Finland. Sakatti and Rompas–Rajapalot are the only discoveries of significant mineral deposits made in the last decades in the country [29]). Sakatti and Sokli are world-class deposits, while Juomasuo, Rompas–Rajapalot, and Heinävesi are important deposits for the green energy transition, as they involve battery minerals (cobalt and graphite). Ref. [15] classified the MMEDs examined here as of low intensity (some local organizing). This follows the EU trend regarding MMEDs, where most of them occur in the form of a public debate [11,21].

This paper is a continuation of [15] article, adding the spatiality of the selected MMEDs to deepen their analysis. The aim is to contribute to the debate on SLO dynamics, as well as the role of land-use issues in it, from the geosystem service perspective. Another purpose is to emphasize the importance of sensitive contexts for the SLO and call for a holistic consideration of the diverse products of geosystem services in integrated land-use planning.

2. Geosystem Services, Land Use, and MMEDs

Most mineral deposits were formed millions or even billions of years ago. Their generation occurred through special geological processes under favorable conditions in appropriate mineral systems [30] that form a part of geosystem services [31–34]. Ecosystem services refer to biotic nature and are defined as "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life" [35] (p. 3), when as the concept of geosystem services is related to abiotic nature, i.e., geology [31]. Geosystem services can be recognized as the goods and functions associated with geodiversity, which contribute to human well-being specifically resulting from the surface and subsurface [32,33,36]. The products of geosystem services provide society, for example, with arable land, groundwater, geothermal energy, and mineral raw materials [31–34]. However, geosystem services have also shaped the landscapes that can be suitable, among others, for tourism, recreation, wind farms, reindeer herding, or as habitats for rare species. The wide range of geosystem services is a direct result of the planet's geodiversity [31]. Together, geosystem and ecosystem services form natural capital [36,37], which is nature's equivalent to 'economic or social capital'. Natural capital is defined by the World Forum on Natural Capital as "the world's stocks of natural assets, which include geology, soil, air, water, and all living things" (https://naturalcapitalforum.com/about/ accessed on 6 July 2022).

Geosystem services emerged from the debate on the conservation of geoheritage and geodiversity in the 2000s [31,38]. According to [39], geoheritage is defined as those parts of the planet's geodiversity that may be specifically identified as having geoconservation significance, whereas the term 'geodiversity' has been defined as

> *"the natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (landform, processes) and soil features. It includes their assemblages, relationships, properties, interpretations and systems."* [38] (p. 8).

Over 30 values of geodiversity have been identified [38] based on:

- Intrinsic value (free of human valuation);
- Cultural values (e.g., Uluru, Ayers Rock, Australia);
- Aesthetic values, i.e., *geo-aesthetics* [40] (e.g., Grand Canyon);
- Economic values (e.g., oil, coal, construction geomaterials, metals, gemstones);
- Functional values (e.g., geodiversity creates biodiversity);
- Scientific/educational values (e.g., Joggins Fossil Cliffs).

These values can be referred to as '*geosystem services*' [31]. Beyond economically valuable mineral deposits, geosystem services have also produced landscapes and geological features, which are their most prominent and evident examples. All landscapes are at least partly geological, both in the countryside, with spectacular rock outcrops, varied topographies, and active geo-processes, and in urban areas, with the use of geomaterials [37]. [36,38] complemented the list of geosystem services above, among others, with:

Supporting

- Soil processes
- Biodiversity and habitat provision
- Land and water as platforms
- Burial and storage

Provisioning

- Food and drink
- Nutrients and minerals
- Energy sources
- Geomaterials
- Ornamental products
- Fossils for sale

Cultural

- Environmental quality
- Geotourism and leisure
- Cultural, spiritual, and historical meaning
- Artistic inspiration
- Social development

Knowledge

- Earth history and geoheritage
- History of georesearch
- Environmental monitoring and forecasting
- Geoforensics
- Education and employment

These were described in detail by [36]. The geosystem service framework has been applied to the sustainable management of coastal natural resources [41], geodiversity and water resources evaluation [42], environmental impact assessment regarding geodiversity [43], evaluation of geodiversity's cultural services [44], mapping of geosystem services in mountains [45], and tourism studies [46]. Here, we apply the geosystem service concept and framework to examine the spatial reasoning behind MMEDs.

Geodiversity, i.e., variation in lithologies, geological units, and their diverse responses to weathering and erosion in a determined area, has produced landscapes that have geoaesthetic value but can also be used for sports and recreation [37]. These places may have been turned into nature-based tourism resorts, of which there are several examples in northern Finland, such as Ylläs in Kolari and Ruka in Kuusamo (Figure 1). Lapland, the region between these two locations with prominent reliefs, is among the areas with the highest geodiversity in the country [47]. The landscape of northern Finland is characterized by forests, large mires, fast-flowing rivers, and some distinctive fells (highest 719 m a.s.l.) rising from an otherwise flat terrain [14]. The lithologies more resistant to weathering and erosion that emerge from the surroundings in such examples are quartzites. In the deep past, these metamorphosed sands were deposited on beaches and in rivers at the margins of an incipient ocean in a humid tropical climate [48]. This ocean closed and the entire pile of volcanic and sedimentary rocks deposited in its basin was intruded by granitoids and deformed by continental collision to form an orogen [48]. These events formed the conditions for mineral systems with the generation, circulation, and entrapment of mineralized fluids across northern Finland. The mineral deposits of Juomasuo in Kuusamo, Rompas–Rajapalot in Ylitornio, and Hannukainen in Kolari were formed in these processes [49–51]), whereas Sakatti in Sodankylä was generated by magmatism related to rifting [52]. Substantial time and erosion were needed to bring the mineralization closer to the surface and left only the more resistant remnants of the ancient mountain chain as prominent hills in the landscape. For instance, the interplay of tectonic, glacial, and post-glacial processes also shaped the Saimaa Lake region in southeastern Finland. Geological processes generated the graphite deposit of Aitolampi in Heinävesi by deposition, deformation, and metamorphism of organic matter [53]. Due to its lakes formed in shear and fracture zones, the Saimaa region is a suitable environment for vacation homes (hereafter called cottages, from Finnish word mökki) and tourism. The Sokli region was intruded by carbonatitic magma at ca. 360 Ma, which, together with weathering, generated an important phosphorite, niobium, and uranium deposit also having potential for

REEs [54]. Much later, the same place turned into a suitable environment for reindeer herding.

Beyond landscapes and mineral deposits, rocks, soil, and minerals offer substrates for crops and plants, from which they take their nutrients. A mineral deposit and its associated lithologies, their weathering and the landscape may also have created fragile ecosystems with rare species that need to be protected, such as in the Rompas–Rajapalot and Viiankiaapa Natura 2000 areas in Ylitornio and Sodankylä, Finnish Lapland. Natura 2000 areas are PA units based on an EU nature directive [55]. According to the [55], economic activities, such as mining and mineral exploration, are allowed within Natura 2000 areas, but care should be taken to not significantly harm the protected biodiversity.

Therefore, geodiversity and its geosystem services also form the basis for ecosystems. Sometimes, the diverse products of geosystem services may overlap, as in the case of mineral deposits, tourist resorts, lake areas with cottages, reindeer herding areas, or PAs, and this overlap may cause controversies and conflicts.

Generally, the reasons for mining-related conflicts are environmental and social impacts, the lack of participation of local people in decision making, a lack of trust in companies and authorities, and poor procedural and distributional fairness [9]. However, according to [56], there are also communities that do not resist mining. It is common to resist when a threat to health or livelihood is perceived, and the associated land use can have a crucial role in this perception [7–9,13,15].

The SLO is a fundamental concept when dealing with MMEDs [57]. The SLO is not a formal license granted by authorities, but a consent given by the local people. It can be a long and difficult process to achieve it and there are no clear signs when this happens, but its loss can occur at any moment and is often clearly indicated by protests, appeals, blockades, and conflicts [57].

Ref. [19] observed that the national-level SLO is influenced by multiple factors, such as governance, procedural and distributional fairness, and trust in authorities and the industry. According to [17], uranium associated with a deposit, the balance between benefits and impacts, and resource nationalism also matter regarding the SLO in Finland. In addition, perceptions and beliefs may also be influenced by other issues such as place identity and dependence on impacted natural resources for livelihoods and deserve further research [17]. In fact, as [15] observed, the project location and its associated land use also influence the SLO in Finland.

3. Materials and Methods

The cases examined in this study were selected from a recent identification and mapping of 20 ongoing Finnish MMEDs [15], on which their descriptions are also mainly based. The selection was based on their clear association with one or more overlapping land-use issues, and most of the cases have been long-standing disputes and represent diverse commodities. There is also academic literature on them. Here, the cases are described, updated, completed, and their associated land-use issues are spatially analyzed and discussed from the perspective of the geosystem service concept. The geosystem services in question are related to both their subsurface and surface manifestations in the form of mineral deposits, geomorphology, water systems, soils, and their associated land uses. The spatial analysis is based on maps generated with a geographic information system (GIS) by using ArcGIS 10.6.2 software, in which several datasets were combined to illustrate each case's land-use issues, their locations, and mutual relationships with the respective permits. The spatial data are comprised of mining and mineral exploration permits issued by the Finnish Mining Authority (Finnish Chemical and Safety Agency—Tukes), PAs by the Finnish Environmental Agency (SYKE), and the Topographic map database and LiDAR data of the National Land Survey of Finland (Maanmittauslaitos).

Table 1 summarizes the cases and their characteristics (projects, companies, commodities, localities, issues/concerns, indicators, and contentious actors), while Figure 1 presents the locations of the selected MMEDs. Table 2 was constructed to better illustrate which land-use issues are associated with each of the selected projects.

Table 1. Mine and mineral exploration projects facing ongoing opposition in Finland, with their localities, commodities, holding companies, issues, indicators, and the main organized contentious actors in 2020–2022. See the projects and localities in Figure 1. FANC = Finnish Association for Nature Conservation. PA = protected area. REE = rare earth elements. After [15].

Project/Locality and Commodities	Company/Parent Company	Issue(s)/Concerns	Indicator(s)	Main Contentious Actor(s)
Aitolampi/Heinävesi, Rääpysjärvi/Tuusniemi, mineral exploration: graphite	Grafintech Oy/Beowulf Ltd.	Saimaa Lake area, cottages, tourism, reputation	Ref. [26], organized movements, social media group, petition	Pro Heinävesi movement
Hannukainen/Kolari, mine project: iron, copper, gold, cobalt	Hannukainen Mining Oy/Tapojärvi Oy	Tourism, reindeer herding, PAs	Ref. [24], organized movement, social media group, petition	Pro Ylläs association, cottage owners
Juomasuo/Kuusamo, mine project: gold, cobalt (uranium)	Latitude 66 Cobalt Oy	Tourism, PAs, uranium	Ref. [27], organized movement, social media groups	Kitkan Viisaat association, Pro Kuusamo association
Rompas–Rajapalot/ Ylitornio, mineral exploration: gold, cobalt (uranium)	Mawson Resources Oy	PA, uranium	Ref. [28], appeals, court rulings	FANC, environmental authorities
Sakatti/Sodankylä, mine project: nickel, copper	Sakatti Mining Oy/Anglo American plc	PA, reindeer herding	Ref. [25], organized movement, social media group	FANC, Viiankiaapa movement
Sokli/Savukoski, mine project: phosphorus, niobium, uranium, REE	Finnish Minerals Group	PAs, reindeer herding, uranium	Ref. [23], organized movement, social media	Wilderness Sokli movement, FANC

Table 2. The projects and their sensitive land-use issues related to mining and mineral exploration disputes in Finland.

Issues / Projects	Water System with (or without) Cottages	PA	Reindeer Herding	Tourism Destination	Association with Uranium
Hannukainen	x	x	x	x	
Heinävesi	x	x		x	
Juomasuo	x	x		x	x
Rompas–Rajapalot		x			x
Sakatti		x	x		
Sokli	x	x	x	x	x

4. Case Description

The selected six contentious projects are listed in Table 1, together with their operating companies, nationalities, commodities, localities, issues/concerns, indicators, and contentious actors. The cases are described in more detail below.

4.1. Hannukainen

The Hannukainen iron, copper, and gold mine project is located in Kolari, northwestern Lapland (Figure 2), and is one of the most studied MMEDs in Finland [24,58–61]. It was formerly operated by the national state-owned company Rautaruukki Oy, which closed it in 1985. Plans for reopening the Hannukainen mine were started in 2005 by Northland Oy, which went into bankruptcy in 2014 [24]. Hannukainen Mining Oy, owned by the Finnish company Tapojärvi Oy, restarted the mine development in 2015 [62].

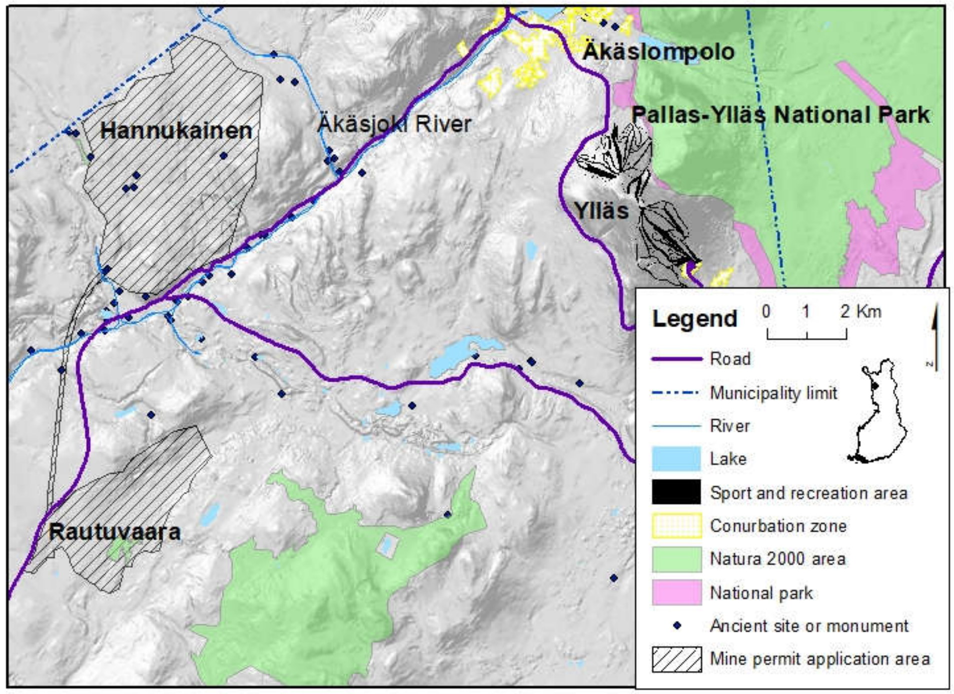

Figure 2. The Hannukainen project, Ylläs resort, and surrounding PAs in Kolari, northwestern Finland.

At the beginning of the Northland's mine project, its relationship with the community was good, despite the distance between the mine site and the Ylläs Resort being only 10 km [24] (Figure 2). Opposition was started by local and international tourism entrepreneurs and cottage owners in 2013, which coincided with a poll and disclosure of its results about the attitudes of tourists and tourism entrepreneurs regarding the mine project [63]. The results revealed that they feared that a mine could negatively impact tourism. Moreover, soon after, the company was unable to keep up its stakeholder engagement because of economic difficulties [24,59]. Talvivaara nickel mine's gypsum pond leakage in 2012 negatively influenced the mining debate in the whole of Finland [64], which was also reflected in the local debate about Hannukainen [59]. The change of project holder did not alter the situation. In 2019, a petition against the mine project gathered 51 000 signatures [65] (Table 1). However, a following poll revealed that locals support the mine [66]). Therefore, as [14] and references therein also pointed out, the local population is divided towards the project, whereas cottage owners and tourists mostly oppose it.

The main reason for the dispute is controversy regarding land use, as the region is a popular destination for skiing and hiking and reindeer herding is also practiced therein. As shown in Figure 2, PAs are also found nearby (Tables 1 and 2). In addition, there are numerous hotels, cottages, and tourism entrepreneurs dependent on tourism. The opposers fear not only environmental damage to the Tornio and Muonio rivers, but also that the region's image and local livelihoods might be negatively impacted due to the mine [60,61]. The Äkäsjoki river is one of the tributaries of the Tornio and Muonio rivers (Figure 2).

Within the spatial study covering central and western Lapland, Hannukainen emerged as a case in which potentially controversial industrial activities, such as forestry and mining, overlap with reindeer herding, recreation, PAs, and nature-based tourism, indicating the potential for conflict [14]. Ref. [61] examined such overlaps regarding Hannukainen in more detail from the point of view of land-use planning and the reconciliation of diverse interests. She concluded that the reconciliation of mining with reindeer herding, and nature-based tourism is not possible in the Ylläs region, because the positions of the parties are too distant from each other.

However, Hannukainen has been designated as a potential mine area in the province-level regional land-use plan due to the past mining activity in the area [67]. Nevertheless, according to [60,61], following the previous mining activity and the preparation of the land-use plan, tourism and PAs have expanded in the surroundings. Indeed, the regional plan was created to preserve the status of the area as suitable for mining in the future. Therefore, Hannukainen is an example of the *safeguarding of a mineral deposit* (see [68] by a regional plan in Finland. According to a statement by the Lapin liitto in [69] regarding a new mine permit license, planning of the area should consider the touristic, recreational, and natural value of the area close by. Due to the nearby Tornio and Muonio rivers being included in a Natura 2000 area, mining should be planned in such a way that it would not cause significant emissions or hydrological impacts and would not significantly weaken the natural values due to which it was included in the Natura 2000 network (statement by Lapin liitto in [69].

The region in which Hannukainen is located is highly prospective for iron oxide–copper–gold (IOCG)-type deposits [50]. It is currently and will probably remain a subject of intense mineral exploration in the future.

4.2. Heinävesi

Oy Fennoscandian Resources Ab (currently Grafintec Oy) applied for a permit in 2016 for graphite exploration of the Aitolampi prospect in Heinävesi (Figures 1 and 3). The dispute started in summer 2018, when a representative of the Finnish Association for Nature Conservation (FANC) gave an interview to a newspaper about the project and said that the supposed mine "will pollute the whole Saimaa Lake area" [70]. Other causes for the dispute seem to have been the company's poor corporate conduct and communication [26]. In addition, the surrounding lake region is a popular summer tourist destination. Many celebrities and politicians own cottages in the region and have joined the campaign against the project, together with local monasteries and the Finnish Lutheran Church. This increased the negative public image of the project [71]. The region also contains PAs, and its waterways are an iconic national landscape (Figure 3). The Varisvesi waterway forms a protected landscape ensemble that was formed along a northwest–southeast-trending fracture zone. The mineral exploration permit of Grafintec Oy is for an area located 0.5 km from the shore of the Varisvesi waterway (Figure 3).

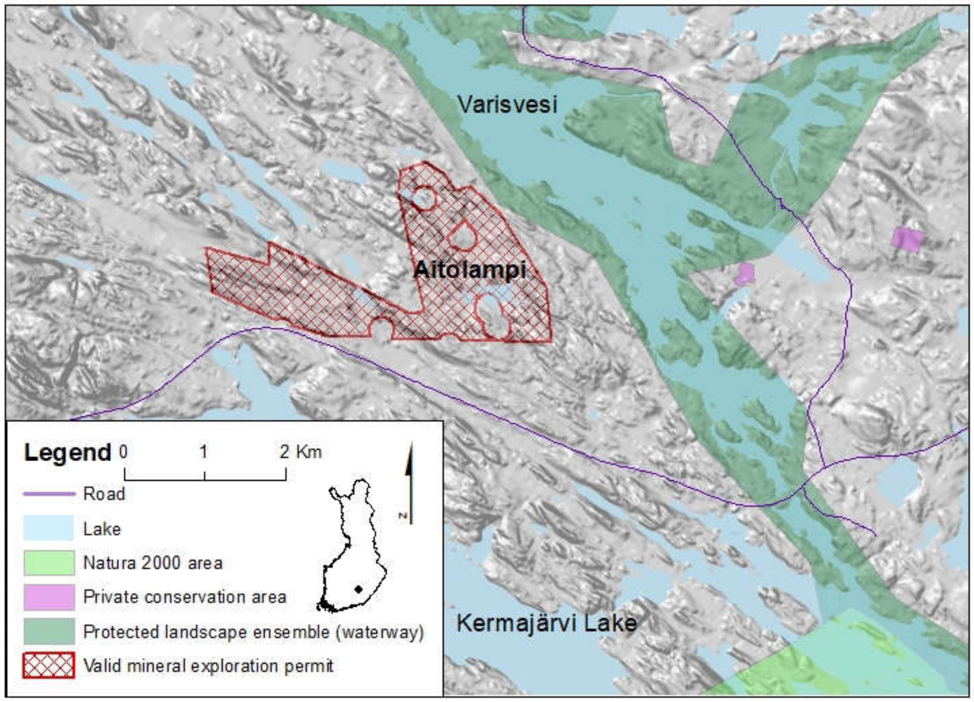

Figure 3. The Aitolampi project in Heinävesi, southeastern Finland.

The Pro Heinävesi movement was established to resist the project through its social media group in 2018 (Table 1). Since then, the public meetings between the company and community have attracted more attention and have been quite tumultuous and noisy [26,71]. movement conducted a successful campaign for a popular petition to demand a revision of the national Mining Act [26] (Table 1). Due to resistance, the company postponed the project to concentrate on the environmental impact assessment (EIA). The municipality and province administrations both oppose the project. A proposal for a private PA in the company's permit area challenges the company's project, and the case is in court [72].

Beowulf Ltd., the parent company of Grafintech Oy, was involved in a dispute over the Gállok Project in Sweden (see [10,73]) and because of this it came to Finland with an already poor reputation [74]. Due to the parent company's reputation and poor corporate conduct, which generated opposition and precipitated a petition for reform of the Mining Act, the case was found by [75] to be in a situation in which all three business risks (political, reputational, and local acceptability) were realized in conjunction. This is an example of a case in which geosystem services generated a mineral deposit in a region that is an environment favorable for tourism with cottages along the shores of lakes, fueling opposition. The Heinävesi case shows that cottage owners are among the most influential stakeholders of the mining industry in Finland.

4.3. Juomasuo

Juomasuo is a gold–cobalt mine project in Kuusamo, northeastern Finland (Figure 1). The deposit was discovered by the Geological Survey of Finland (GTK) in the 1980s [49]. Juomasuo's association with uranium incited opposition towards the project since and due to its former holder, Dragon Mining Oy [76]. Dragon Mining Oy also applied for mineral exploration and mine permits close to the Ruka Resort [77,78]. After its rejected environmental license application, the Juomasuo prospect was sold to the Australian company Kuusamo Gold Oy in 2015. In 2017, the new project holder changed its name to Latitude 66 Cobalt Oy.

Although the company has been more open and communicative, opposition has proceeded. A poll performed in February 2018 revealed that almost half of the local people opposed the mine project in the region [79]. Company–community meetings have been also tumultuous. An attempt by the Municipality of Kuusamo to exclude mining from the county through land-use planning was considered illegal by the Supreme Court [80]). The mine project is located 8–10 km from PAs and leisure centers (Figure 4). The dispute mainly relates to the associated uranium and the controversial use of land, i.e., nature-based tourism vs. mining [27]. The Kitka River is located ca. 1 km from the intended Juomasuo mine, and it is feared that its effluents may pollute the river [76].

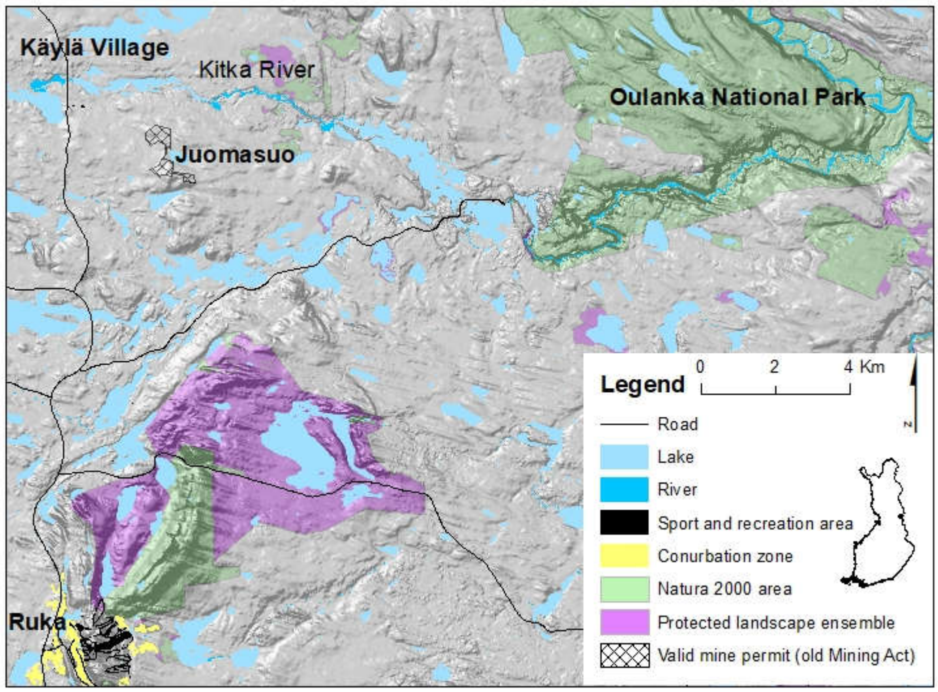

Figure 4. The Juomasuo project, Ruka resort, and surrounding PAs in Kuusamo, northeastern Finland.

4.4. Rompas–Rajapalot

The Rompas gold–cobalt deposit in Ylitornio, northern Finland (Figures 1 and 5), was discovered in 2008 by the French nuclear company Areva. Areva sold the prospect to the Canadian company Mawson Oy in 2010, which expanded its activities to the Rajapalot area (Figure 5). As seen in Figure 5, the Rompas–Rajapalot project partially overlaps PAs, and along with the associated uranium, it is opposed by the FANC [81]. Mawson, FANC, and the environmental and mining authorities have been involved in a long legal battle. Several requests for criminal investigations regarding the environmental impacts within the PA have been made towards the company and FANC (e.g., [82]. Mawson's employees have been fined for environmental damage. However, most of the local population seems to not oppose exploration (Beland Lindahl et al., submitted), but the government, the authorities, and the municipality have controversial positions. The environmental authorities have been critical towards operation within the PAs [82]. The Ministry of the Environment has a plan to expand PAs in the prospect area, but this is opposed by the municipalities of Rovaniemi and Ylitornio, and the project is favored by local politicians. According to [83], the company has announced the start of mine planning and an EIA of the project.

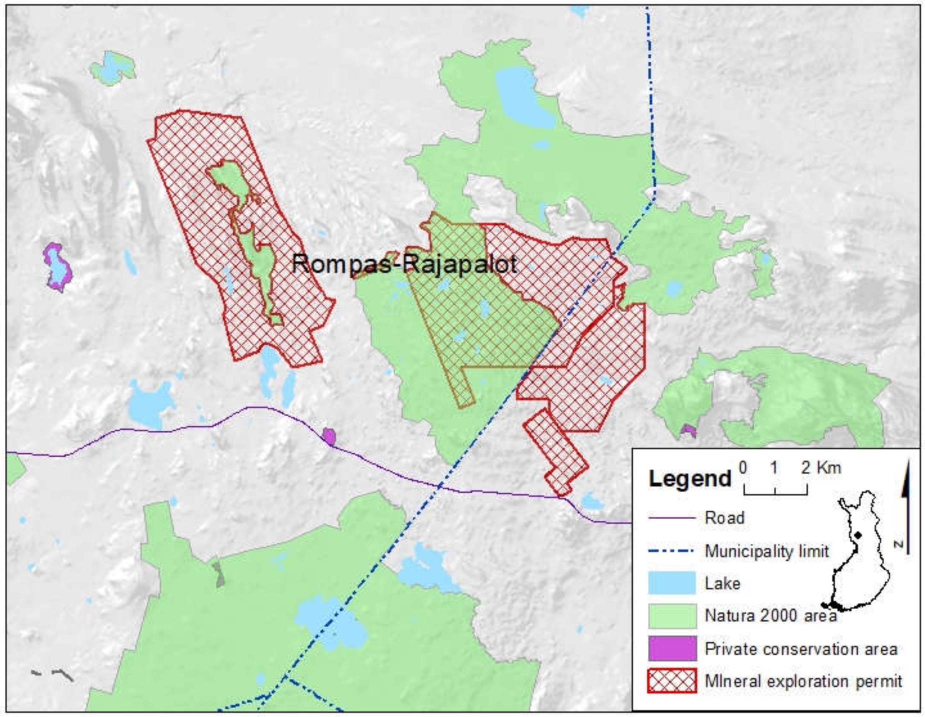

Figure 5. The Rompas–Rajapalot project in Ylitornio, northern Finland.

4.5. Sakatti

The development project of Sakatti nickel–copper–PGE mine is located in the municipality of Sodankylä in northern Finland (Figure 1). Sodankylä already hosts the Kevitsa nickel and Pahtavaara gold mines and is a focus of intense mineral exploration. The Sakatti deposit is located on the margin of the Viiankiaapa mire Natura 2000 area (Figure 6). The deposit was discovered in 2011 by AA Sakatti Mining Oy, which is a subsidiary of the British company Anglo-American plc. Due to the overlap with the PA, the project has been opposed by FANC [84] (Tables 1 and 2), and the company is exploring the development of an underground mine to not affect the PA [85].

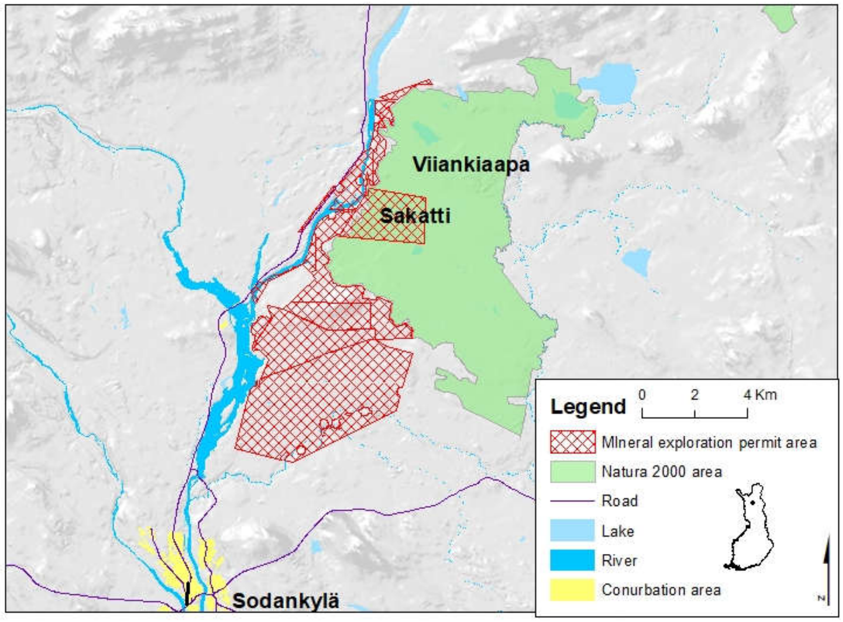

Figure 6. The Sakatti project in Sodankylä, northern Finland.

According to polls, the majority of the local people in Sodankylä seem to favor the mine project and mining in general, although there is also some local opposition [25,86–88]. According to [87], local people show more trust towards the company than the municipality and the mining authorities. The local community has also pressured the company to provide better economic benefits from the project. Sodankylä municipality plans to establish a mining forum, agreement, and program, which would be the first in the EU [87,89]. Nevertheless, Sakatti was also identified by [14] as a case of mining versus reindeer herding, recreation, and an overlap regarding the Viiankiaapa PA, showing its potential for conflict.

4.6. Sokli

The phosphorus deposit of Sokli in Savukoski, northern Finland (Figures 1 and 7), has been investigated and developed since its discovery in 1967 [90]. Several attempts to establish a mine have been obstructed by its remote location and lack of appropriate infrastructure, which have made the deposit economically unfeasible so far [90]. In 2007, the deposit was acquired by the Norwegian company Yara Finland Oy, which had plans to develop it [90]. Recently, the deposit was sold to the state-owned Finnish Minerals Group [91]. The company plans to produce phosphorus for fertilizer, as well as uranium, niobium, and REE.

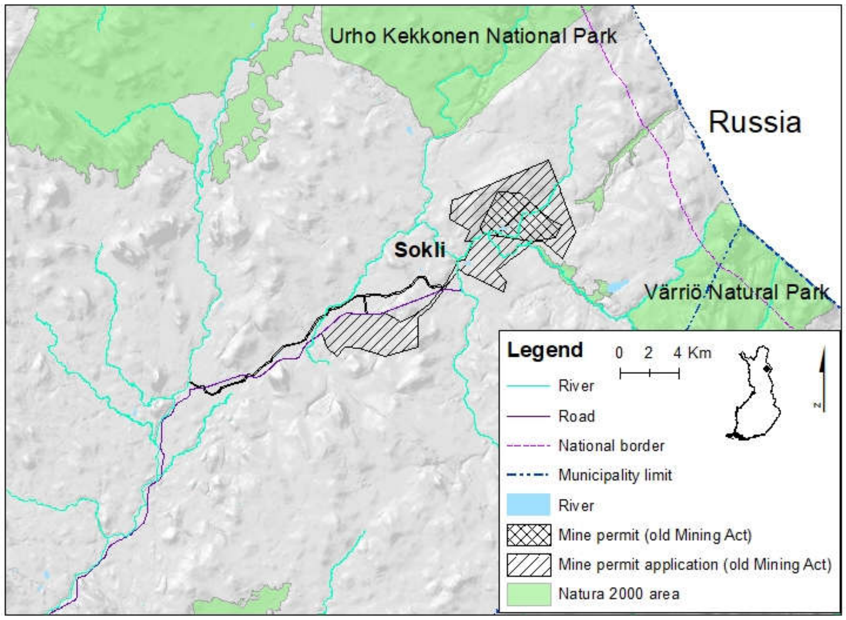

Figure 7. The Sokli project in Savukoski, northeastern Finland.

Due to its associated uranium, opposition to the Sokli project emerged in 2007, when Yara Finland Oy acquired the prospect and announced its plans to establish a mine [77]. Therefore, it is the oldest ongoing mining dispute in Finland. Additionally, the deposit is located between and close to PAs and there is reindeer herding in the area [92] (Figures 1 and 7, Tables 1 and 2). Appeals to the Supreme Court were presented by the reindeer herders and FANC against the permits, and the environmental permit application was rejected [93]. Allegations of damage to tourism have also been presented [23,93], although the area is not close to a tourism center or even within any tourism attraction zone (see [94]. The opposition to the project requests the expansion of the PAs to also cover the Sokli area, which would then block any attempt to develop a mine therein [95]. Despite the opposition, local people, the government, the municipality, and the provincial authorities have supported the mine project due to its employment potential and support for the regional development policy of eastern Lapland [90]. However, local people have also been frustrated because of several successive failures in mine establishment during recent decades [90].

5. Analysis

The cases and their characteristics are summarized in Table 1, and their land use issues are systematized in Table 2, helping to quantify them. The cases are analyzed below. The MMEDs examined hereby are represented by cases of advanced mineral exploration and mine planning projects. Most of the projects are in northern Finland, especially Lapland, and only one of them is in southeastern Finland (Heinävesi) (Figure 1). Sokli is the oldest dispute, whereas the Heinävesi case is the most recent one.

All the projects described above face opposition from the local community and/or NGOs and most of them have incited social movements against them (Table 1). As observed by [15] regarding the Rompas–Rajapalot and Sakatti projects, the resistance appears to mostly be represented by FANC, but some local opposition also exists especially in the case of Sakatti. As pointed out by [15], the project holders appear to have managed their relationship with the local communities well, despite their operation in sensitive contexts.

As seen in Table 1, most of the companies involved with the MMEDs are of foreign origin, and only two are Finnish ones. Therefore, and based on other cases of Finnish companies involved in MMEDs presented by [15], the domestic origin of a company does not appear to be any guarantee of obtaining the SLO in Finland, despite resource nationalism (see [17]). Other issues than nationality might be more important in this regard. Indeed, apart from Heinävesi, and Sakatti, all the disputes were inherited from the former project holders. Common to all the described projects is that the main reasons for their resistance are related to land-use issues, while three cases also involve deposits associated with uranium (Tables 1 and 2). The most common sensitive issue related to land use as a cause for disputes is a PA (Table 2), which is present in all the studied cases, followed by a water system with or without cottages, reindeer herding, a tourism destination, and uranium. Commodities (e.g., uranium, coal, sulfides) may also create MMEDs in Europe and Latin America [11,13,96].

Although there is dispersion of issues between the cases (Table 2), Sokli has the largest number of them (five), followed by Hannukainen and Juomasuo with four each. The mentioned projects have a PA, a water system with or without cottages, reindeer herding, tourism, and an association with uranium as causes for their opposition. Sokli in Savukoski, Aitolampi in Heinävesi, Juomasuo in Kuusamo, and Hannukainen in Kolari are examples of cases in which the reasons for disputes include tourism and water systems with cottages. Although Sokli is not significant for tourism or cottages, they are examples of the so called NIMLA ('not in my leisure area') phenomenon in Finland [15]. NIMLA is a concept derived from NIMBY ('not in my backyard'), and characterizes a controversy between tourism, cottages, and any project that allegedly poses a threat to them. NIMLA cases show the influence that cottage owners and tourists may have on MMEDs in Finland. Tourism has also been highlighted as a reason to oppose mining elsewhere, with allegations that tourism would be harmed by mining (e.g., [11,13,97–99]).

For instance, the issues regarding Sakatti and Rompas–Rajapalot are mainly related to PAs due to the partial location of the projects within Natura 2000 areas, but Rompas is also associated with uranium. Regarding Hannukainen, Sakatti, and Sokli, reindeer herding is also a cause for dispute. Reindeer herding is also a cause for MMEDs in northern Sweden, where the issue is related to indigenous Sámi people [13]. Even though Hannukainen, Juomasuo, and Sokli are not located within PAs, their proximity to PAs has been considered as a reason for opposition [61,76,92]. The same concerns regarding the proximity of projects to water systems with cottages apply to Hannukainen, Heinävesi, and Juomasuo.

Mining, Mineral Exploration, Land Use, and Geosystem Services

Land-use planning has a crucial role in some of the examined cases. Hannukainen is an example of a controversial mine project and mineral deposit safeguarded by land-use planning. It was recognized as an asset for potential future mining. In contrast, the municipality of Kuusamo unsuccessfully used land-use planning against a mine project, whereas the expansion of PAs is intended to be used to block mining regarding Sokli, Heinävesi, and Rompas–Rajapalot. These projects are economically important raw material resources for the green transition and fertilizers.

In the case of Hannukainen and Juomasuo, geosystem services have generated ore deposits in the same regions where a prominent quartzite hill is located, together with natural values appropriate for nature-based tourism, PAs, and reindeer herding, and their overlap creates controversies. For instance, the Heinävesi case is an example of controversies generated by a mineral deposit in a lake area with cottages. According to [15], these types of disputes have become common due to the battery minerals boom, with companies applying for mineral exploration permits in such regions with cottages in southeastern Finland. The Heinävesi case opened a new contentious cycle focused on mineral exploration in Finland [15].

Regarding Rompas–Rajapalot and Sakatti, geosystem services have generated an economically exploitable mineral deposit in a location in which its associated lithologies and topography form an appropriate ecosystem for rare species to be protected. In those cases, the overlap of natural and economic values has led to a dispute between them. As in the cases of Hannukainen and Juomasuo, the PAs close to the Sokli deposit do not overlap with the project area (Figure 7), but reindeer herding does (see Figure 1).

The cases presented and analyzed in this study are examples of controversies generated between the diverse products of geosystem services. While these services produced economically exploitable mineral deposits, they also produced landscapes and ecosystems favorable for tourism, recreation, reindeer herding, and PAs. The challenging question is how to fit all the useful and needed activities into one region in a sustainable way, to create synergy between them and avoid conflicts. According to [61], this might not be possible in some places, such as in Ylläs. When several sensitive forms of land use prone to conflict with mining (PAs, tourism, and reindeer herding) overlap, as in Kolari, this might be the case. Such areas may be classified as potential no-go zones for mining and mineral exploration due to their high risk of conflict [15,100]. However, the underrepresentation of geosystem services in ecosystem assessment, which leads to the undervaluation of nature, is problematic, as it negatively impacts decision making in spatial planning, environmental policy making, and long-term ecosystem management [34]. Better consideration of diverse types of geosystem services in each region may help to accommodate them together in a more harmonious way.

Mines can be managed in a responsible manner by taking the environment, the local community, and livelihoods into account and by mitigating their negative impacts. It is also possible to build synergy between a mine and tourism in the form of geotourism [38]. While companies should take the sensitive contexts in account in their target selection, planning, and risk analysis, online maps provided by national geological surveys are recommended to be checked by tourism entrepreneurs, decision makers, land-use planners, and cottage buyers to become aware of whether there are mineral potential zones or deposits at or close to an intended resort, cottage, or PA. This may prevent surprises related to potential mine and mineral exploration projects in the future. Studies such as that of [14] might also be valuable tools to predict potential MMEDs by taking prospectivity, land uses, and people's activities and preferences into account. To achieve a balance between mineral deposits and other land uses, and to prevent MMEDs, the safeguarding of mineral deposits is an option to be considered in land-use planning, especially because of the increasing demand for mineral resources necessary for the green energy transition [68]. Mineral deposits are of public interest because of their importance as sources of raw materials for society. While no-go zones for mining and mineral exploration were requested in the reform of the Finnish Mining Act, the safeguarding of mineral deposits has not yet been discussed in Finland.

6. Conclusions

As project location has rarely been explored in the SLO literature, selected MMEDs and related land-use issues were spatially examined in Finland with the application of the geosystem service concept. Spatiality and the application of the geosystem service concept widened the perspective for examining MMEDs and their reasoning. It was found that the overlap of mineral deposits with other products of geosystem services, such as suitable landscapes and conditions for tourism, recreation, PAs, water systems with cottages, reindeer herding and association with associated uranium, may create MMEDs, which classifies them as sensitive contexts, i.e., territories of contention [15]. All the inspected projects have faced opposition from local communities and/or NGOs, and contentious social movements have been created in their localities [15] (Table 1). Therefore, this article emphasizes project location as a fundamental reason for the occurrence of MMEDs in Finland.

There have been attempts to block some of the projects through land-use planning by expanding PAs or excluding mining from the municipality. Conversely, one project is an example of the safeguarding of mineral deposits by province-level land-use planning, although tourism has expanded around the old mine site since the previous mining activity.

The locations of economically exploitable mineral deposits were determined in natural geological processes millions or even billions of years ago. Nowadays, these locations overlap with other geosystem service products that create divergencies between diverse land uses. This overlap has serious implications for obtaining the SLO for mining and mineral exploration and needs to be taken into account by companies in their target selection to avoid MMEDs. However, land-use planners and decision makers need to be better informed to reconciliate the diverse interests. Furthermore, citizens, cottage buyers, and tourism entrepreneurs can examine open online maps on mineral potential zones and deposits to become aware of their location. A discussion on the safeguarding of mineral deposits is also recommended as an option to prevent further controversies between diverse geosystem products.

Corporate conduct, i.e., procedural, and distributional fairness, together with advance planning and responsible target selection to avoid sensitive contexts, have a strong role to play in the SLO. However, even effective stakeholder engagement and benefit sharing may not assist in obtaining the SLO if a MMED is inherited from a previous project holder in a sensitive context.

Although land use associated with a project location has been relatively rarely explored in the literature concerning the SLO, sensitive contexts may not only be applicable to Finland. They may well be a universal phenomenon, although the issues may differ. Water systems with cottages with the NIMLA phenomenon and reindeer herding are typically Nordic issues, but tourism, PAs, and commodities are also critical issues for MMEDs elsewhere. Research in this sense is needed with a focus on the associated land use and its influence on the SLO.

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