Mining conflicts in the European Union: environmental and political perspectives

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Comprehensive knowledge on the issues contributing to mining conflicts is crucial in balancing between the exploitation of mineral deposits and local claims. We explore recent mining conflicts in the European Union using information derived from the Global Atlas of Environmental Justice to improve the understanding of the potential impacts of the intensification of mining activities by the new minerals policies. The variety of causes of conflict is wide and ranges from environmental impacts to socio-economic and health concerns of the populations residing in the vicinity of the mines. While mining conflicts have arisen during all the phases of the life cycle of a mine, new mining projects have been well presented amongst the conflicts. Policy makers should increasingly pay attention to the multiple impacts that mining has had on the environment and socially, in order to be able to put the plans for increasing minerals extraction in Europe into practice.

Keywords: Global Environmental Justice Atlas, energy minerals, Europe, minerals policy, mining conflict, non-energy minerals

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Introduction

Europe holds rich mineral resources due to its wide variety of geological terranes and has a long history of extracting minerals for use by European societies. In terms of its impacts, mining has a dual role: it has been considered to be crucial for industrial production and regional development, but also to cause significant landscape and environmental changes (De Vos *et al.* 2005; Wirth *et al.* 2012). There has been a revival of political initiatives to increase mining activities in Europe, ranging from the European Commission through the member state governments to a number of European regions that consider mining as an important sector of their regional economies. This means that mining will continue to be an important issue on political and environmental agendas in Europe (Vidal-Legaz *et al.* 2018).

The processes of landscape change and the scales on which land use decisions are made have changed rapidly worldwide during the 21th century. Global actors interact with local and national actors in ways that often have substantial social and environmental consequences (Kotilainen *et al.* 2015; Salo *et al.* 2016; Yakovleva *et al.* 2017). The economic effects of the mining industry occur at national,

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regional, local and company scales, but the direct pressures on the environment and human communities concentrate on the localities in the vicinity of which resource extraction is carried out (Kumpula *et al.* 2011; Meyfroidt *et al.* 2013; Schaffartzik *et al.* 2016; Kotilainen 2018; Schilling *et al.* 2018). Mining activities and building of associated infrastructures tend to change landscapes considerably and have impacts on local environment and ecosystems, other forms of land use, and people's living conditions and comfort. The impacts of mining on the environment and local communities can persist long after the mine closure, not only in the mining site but in the surrounding area as well (Dudka & Adriano 1997; Bridge 2004; Wirth *et al.* 2012; Kivinen 2017; Salom & Kivinen 2019).

As a response to the various negative environmental impacts caused by land use transitions and the utilization of natural resources, environmental conflicts and environmental justice movements have intensified worldwide during the past decades (Martinez-Alier 2001; Martinez-Alier *et al.* 2011; Badera 2014; Helwege 2015; Conde 2017; Wagner 2020). Environmental justice is a concept that links environmental problems with social justice (Wagner 2020). Collaborative spatial databases and maps have become powerful tools to collect, share and publish information on social conflicts around environmental issues (Drozdz 2020). An example of such a work is the Global Atlas of Environmental Justice (EJAtlas) produced by the Environmental Justice Organizations, Liabilities, and Trade (EJOLT) research project (Martinez-Alier *et al.* 2011). The EJAtlas constitutes the largest existing online database that provides information on socio-environmental conflicts from an environmental justice perspective across the globe (Temper *et al.* 2015, 2018; EJAtlas 2019).

Comprehensive knowledge on the issues contributing to mining conflicts is crucial in balancing between the exploitation of mineral deposits and local claims. In this paper, we explore mining conflicts related to the extraction of non-energy and energy minerals in the European Union during the recent decades as they are documented in the EJAtlas. The purpose of this exploration is to improve the understanding of the potential impacts of the intensification of mining activities in Europe by the new minerals policies. Our effort is guided by a characterisation of the environmental and social constraints to the mining industry (Prior 2012). The environmental constraints include increased mine waste, the impacts of the size of a mine, energy intensity, and water pollution. The social constraints include land-use conflicts, cumulative impacts of mining activities, as well as the consequences from mine closure to the mining communities and regions. We ask the following questions: 1) Which minerals are the ones whose extraction has caused conflicts in Europe, and in which phases of mining have the conflicts occurred?, 2) What are the environmental, health and social-economic concerns that have given rise to the conflicts?, and 3) What are the characteristics of the groups which have mobilized and forms of mobilization in the conflicts?

The new mining policy of the European Union

Raw materials policy is a relatively new policy field in the European Union (Tiess 2010, 2011). Of the European Union institutions, the most significant actor for crafting the raw materials policy has been the European Commission. The justification for the raw materials policy is drawn from the future success of the European industries and the employment that the industries provide to the citizens of the EU. Raw materials have been seen as having strategic importance for the manufacturing industry in the European Union, and hence the European Commission has been implementing various actions to ensure supply of raw materials, mainly minerals (European Commission 2017a). Some member states have designed their own, related minerals policies (e.g. Ministry of Employment and the Economy & Geological Survey of Finland 2010).

The Raw Materials Initiative was launched in 2008 (Commission of the European Communities 2008; Tiess 2010). Although the Raw Materials Initiative covers in principle more raw materials than those acquired by mining and includes timber, minerals are clearly its most important aspect, demonstrated by the list of critical raw materials (European Commission 2017a). The European Union raw materials policy rests on three pillars (Commission of the European Communities 2008): ensuring a fair and sustainable supply of raw materials from global markets; ensuring a sustainable supply of raw materials within the EU; and boosting resource efficiency and increasing the amount of recycling and recovery. The second pillar focusses on provision of minerals from European deposits and addresses several issues. There is a need to allocate more land for mining, through an improved consideration of mining in spatial and land use planning (AHWG 2014). As is suggested by the Raw Materials Initiative, a list of critical raw materials has been drawn up three times (European Commission 2014, 2017a). This list is a result of analysis on two axes: one that estimates the economic importance of each raw material, and another that focusses on the risk of shortage in its supply. The most recent version of the list dates to 2017[1]. The list includes a large variety of minerals in terms of their purpose in industrial usage. For example, the list includes light and heavy rare earth elements, necessary for the production of modern energy and information technologies, but also phosphorus, raw material for the production of industrial fertilisers, and thus of utmost importance for current industrial-scale food production. Overall, as a result of the raw materials policy, it is thus one of the explicit policy goals of the European Commission to increase the amount of mining within the European Union. In order to highlight the challenges for such a policy aim, we next explore mining conflicts in Europe.

Studying mining conflicts through the Environmental Justice Atlas

The EJAtlas

Socio-environmental conflicts, also known as ecological distribution conflicts, arise from the growth and changes in the social metabolism, that is, the flows of energy and materials in the economy (Temper *et al.* 2015, 2018). In the EJAtlas, socio-environmental conflicts are defined as "mobilizations by local communities or social movements against particular economic activities, infrastructure construction or waste disposal/pollution, whereby environmental impacts are a key element of their grievances" (EJAtlas 2019). These conflicts are a response of structural inequalities of income and power (Temper *et al.* 2015, 2018). While there are other definitions in the literature on conflicts, and distinction is sometimes made to disputes and other forms of clash between actors, in this paper we draw on the definition of conflict by the EJAtlas.

The EJAtlas contained information of a total of 2,699 conflicts across a wide range of topics in different parts of the world (as of February 2019). The individual conflicts in the database have been reported by scholars, environmental non-governmental organizations (NGOs), social activists, and journalists. Information on the conflicts have been collected through a collaborative online platform and revised and moderated before publication. In the database, conflicts are categorized as unknown, latent, low, medium or high intensity conflicts. Latent conflicts include no visible organizing at the moment. The low intensity conflicts have some local organizing, medium intensity conflicts more visible mobilization, and high intensity conflicts widespread mass mobilization. Each conflict in the EJAtlas contains data about involved groups (activists, scholars etc.), the conflict background, the observed/potential impacts, the claims, and outcomes for stakeholders (Temper *et al.* 2015, 2018; EJAtlas 2019).

The coverage of the EJAtlas database varies between different countries and regions. As information on the occurrence of conflicts is not exhaustive, the EJAtlas is not suitable for rigorous statistical analyses in geographical space. However, it can still provide an important overview of the characteristics of conflicts through the reported cases. The unique open database can contribute to the understandings of the drivers and interconnections for the increasing number of socio-environmental conflicts and the ongoing worldwide sustainability crisis (Temper *et al.* 2015, 2018; EJAtlas 2019). On the basis of the material in the EJAtlas, we can maintain that even if the data on socio-environmental conflicts is not exhaustive globally, at least the conflicts reported in the database exist, and therefore the information is valuable for surveying the character and causes of socio-environmental conflicts, as well as for evaluating the potential of emergence of similar conflicts in the future.

Conflict cases

In the EJAtlas, about 28% of the conflicts were classified into categories 'Mineral ores and building materials extraction' and 'Coal extraction and processing' (EJAtlas 2019; see also Özkaynak *et al.* 2012, 2015). We extracted data on a total of 44 mining conflicts belonging to these categories within the

European Union. We divided the conflicts as those related to non-energy minerals that is metals and industrial minerals, and those related to energy minerals (Fig. 1).

The EJAtlas database contains the name, geographical location and a general description of a conflict. There is also additional information available, such as references, web links, photographs and videos. We derived the following information from the database for each case: 1) location, 2) commodity, 3) start year of the conflict, 4) project status, 5) environmental, health and socio-economic impacts (potential and observed), 6) intensity of the conflict at the highest level, 7) groups mobilizing protest actions, and 8) forms of mobilization. In our analysis, we utilized classifications and variable names used in the EJAtlas.

In the EJAtlas, conflicts are generally named by their geographic location or by the name the conflict is known to the international public (Özkaynak *et al.* 2012). For clarity, we refer to the conflict either by the name of the mine or the name of the location, depending on the mining phase and the type of conflict. For some of the mining projects, there was no updated information available on their current status. Additional information on mining projects was derived from the Mining Atlas (Mining Atlas 2019) and the webpages of the mining companies.

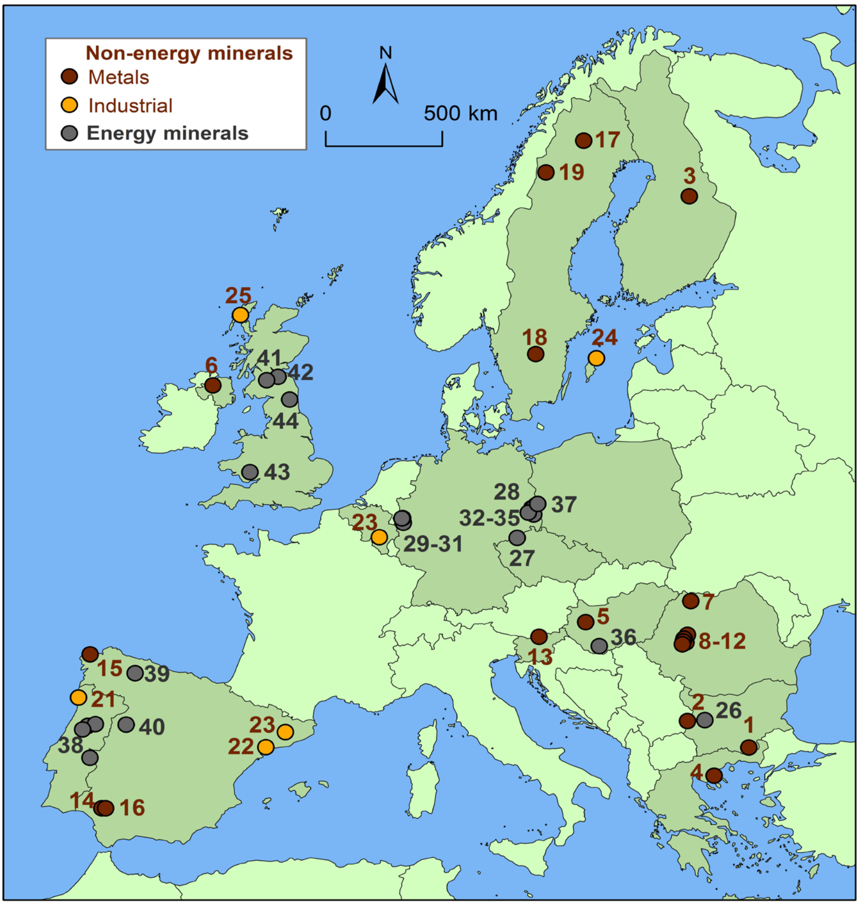

Fig. 1. Mining conflicts related to non-energy and energy minerals reported in the EJAtlas within the European Union. Countries with reported mining conflicts in the EJAtlas are marked with dark green shade. See Table 1 for the names of the sites and Table 2 for conflict details.

Different types of mining conflicts

Minerals and mining phases related to the conflicts

At the time of investigating the EJAtlas, the mining conflicts reported took place in Fennoscandia, the British Isles, Iberian Peninsula, Balkans (the Golden Quadrilateral) and Central Europe (Fig. 1, Table 1). Unsurprisingly, the distribution of the mining conflict sites reflected the locations of the most important European mineral deposits, for example in the Iberian Peninsula, the Baltic Shield and the Alpine-Balkan-Carpathian-Dinaride belt (Blundell *et al*. 2006). Most of the reported conflicts had started during the past two decades. In terms of commodities, 46% of the conflicts included in the EJAtlas were related to metals, 41% to energy minerals and 13% to industrial minerals (Table 2). Over half of the metal mining conflicts were related to gold mining. Other metals that are mined in the conflictual mining sites included for example copper, silver, nickel, zinc, and lead. Energy mineral conflicts were caused most often by lignite or coal mining. Uranium mining covered 21% of the energy mineral conflicts. Industrial mineral conflicts concerned the extraction of lime, kaolin, potash and stone, sand and gravel. Planned or realized openings of new mines dominated the conflicts identified in the atlas, with a half of the conflicts on such projects (the start of the conflicts in 1987–2015). 15% of the conflicts concerned the expansion of an existing mining activity and 13% were protests against operational mining activities. Only 7% of the cases were related to post-mining areas, another 7% to environmental accidents, and 2% to mineral exploration (see Figure 2 for examples).

Table 1. Mining conflict sites (n = 44) within the European Union reported in the EJAtlas.

	Country	Mine/Site		Country	Mine/Site
Metals			**Energy**		
1	Bulgaria	Ada Tepe	26	Bulgaria	Buhovo
2	Bulgaria	Trun	27	Czech Republic	Horni Jiretin
3	Finland	Talvivaara (Terrafame)	28	Germany	Cottbus Nord
4	Greece	Halkidiki	29	Germany	Garzweiler I
5	Hungary	Kolontar-Devecser (Ajka)	30	Germany	Garzweiler II
6	United Kingdom	Omagh	31	Germany	Hambach
7	Romania	Baia Mare	32	Germany	Jaenschwalde
8	Romania	Băiţa-Crăciuneşti	33	Germany	Jaenschwalde-Nord
9	Romania	Certej	34	Germany	Nochten II
10	Romania	Deva Muncel	35	Germany	Welzow-Sued II
11	Romania	Rosia Montana	36	Hungary	Pecs, Hungary
12	Romania	Rovina	37	Poland	Gubin Brody
13	Slovenia	Mezica Valley	38	Portugal	Guarda, Viseu, Coimbra
14	Spain	Aznalcollar	39	Spain	Laciana Valley
15	Spain	Corcoesto	40	Spain	Retortillo
16	Spain	Mina Cobre Las Cruces	41	United Kingdom	Cauldhall
17	Sweden	Gállok/Kallak	42	United Kingdom	Douglas Valley
18	Sweden	Norra Kärr	43	United Kingdom	Ffos-y-fran
19	Sweden	Rönnbäcken	44	United Kingdom	Pont Valley
Industrial					
20	Belgium	La Boverie			
21	Portugal	Barqueiros			
22	Spain	Baix Camp			
23	Spain	Potasas del Llobregat			
24	Sweden	Ojnare Forest			
25	United Kingdom	Harris			

Table 2. Non-energy and energy mining conflicts within the European Union reported in the EJAtlas by commodity, mining phase, the start year of the conflict and the current mining status of the site.

	Site	Commodity	Conflict	Start	Mining status
Non-energy	1	Gold, copper, silver	New mine	2005	Construction
	2	Gold	New mine	2011	Cancelled
	3	Nickel	Env. accident	2006	In operation
	4	Gold, lead, zinc, copper	New mine	2011	Permitting
	5	Aluminium/bauxite	Env. accident	2010	In operation
	6	Gold	New mine	2014	Under development
	7	Gold	Env. accident; new mine	2007	Proposed
	8	Gold	New mine	2012	Proposed
	9	Gold	New mine	2008	Proposed
	10	Gold, polymetals	Exploration	2013	-
	11	Silver, gold	New mine	2002	Proposed
	12	Gold	New mine	2015	Permitting
	13	Zinc, lead	Post-mining	(2007)	Post-mining
	14	Zinc, lead, copper, silver	Env. accident; reopening	1998	In operation
	15	Gold	New mine	2011	Proposed
	16	Copper	Operation	2006	In operation
	17	Iron	New mine	2010	Proposed
	18	Rare minerals, zirconium	New mine	2009	Proposed
	19	Nickel, cobalt, magnetite	New mine	2010	Proposed
	20	Lime	Expansion	2007	In operation
	21	Kaolin	Operation	1965	In operation
	22	Sand, gravel	Operation; several quarries	n.d.	In operation
	23	Potash	Operation	1929	In operation
	24	Lime	New quarry	2012	Cancelled
	25	Stones, sand, gravel	New quarry	1988	Cancelled
Energy	26	Uranium	Post-mining	1943	-
	27	Lignite	Expansion	n.d.	Cancelled
	28	Lignite	New mine and expansion	1989	Post-mining
	29	Lignite	New mine and expansion	1987	In operation
	30	Lignite	Expansion	n.d.	In operation
	31	Lignite	Expansion	2012	In operation
	32	Lignite	New mine	1994	In operation
	33	Lignite	Expansion	2007	Proposed
	34	Lignite	Expansion	2005	Proposed
	35	Lignite	Expansion	2011	Proposed
	36	Uranium	Reopening	2006	Proposed
	37	Lignite	New mine	2009	Proposed
	38	Uranium	Post-mining; several mines	2001	-
	39	Coal	Expansion	1985	Cancelled
	40	Uranium	New mine	2011	Proposed
	41	Coal	New mine	2008	Cancelled
	42	Coal	New mine and expansion	2007	Post-mining
	43	Coal	Operation	2003	In operation
	44	Coal	New mine	2007	Construction

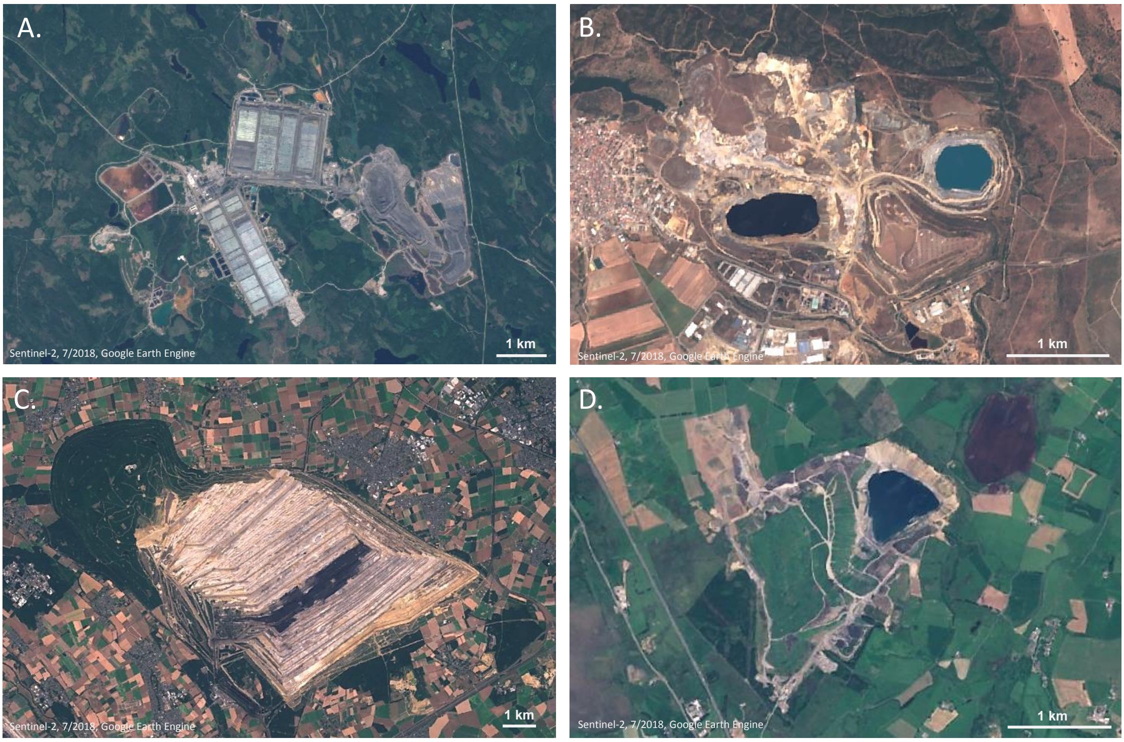

Fig. 2. Examples of mines with conflicts: a) The former Talvivaara nickel mine (currently Terrafame) (3), Finland, located in sparsely populated forested area in Finland; an environmental accident, b) The Aznalcollar zinc-lead-copper mine (14), Spain, located north of the Doñana National Park; an environmental accident, c) The Hambach lignite mine (31), Germany; the contested Hambach forest located on the mine's bottom right corner, and d) The Mainshill coal mine, Douglas Valley (42), Scotland, United Kingdom; contested coal mining has ceased during the past years in the region. Satellite data: Sentinel-2, 7/2018, Google Earth Engine (Gorelick *et al.* 2017).

Environmental concerns

There was a wide diversity of environmental concerns related to the impacts on mining. The most severe environmental concerns included loss of previously existing landscape and aesthetic degradation, surface water and ground water pollution or depletion, air pollution, loss of biodiversity and potential or observed deforestation. These were the concerns that related to more than 80% of the non-energy or energy mining conflicts (Fig. 3). Concerns on mine tailing spills were mainly related to non-energy mining conflicts, whereas concerns on global warming were associated with energy mining conflicts. Other important environmental concerns were for example soil contamination, noise pollution, large-scale disturbance of hydrological and geological systems, soil erosion and reduced ecological/hydrological connectivity.

Gold was the main commodity in nearly 80% of the planned new mines. Among the conflicts related to the planned mines, a cyanide-based process for gold extraction was one important factor mentioned in the EJAtlas reports contributing to concerns of environmental pollution. Environmental concerns related to operational mines were associated with both sudden environmental accidents and environmental issues that developed over a long period of time as a result of poor technologies, or lack of or inadequate post-mining reclamation. The EJAtlas data utilized in this study included four major environmental accidents in Spain, Romania, Hungary and Finland, all related to a dam or pond failure. The Aznalcollar tailings dam failure at the Los Frailes mine (Spain) in 1998 caused tailings and tailing waters to spill into the nearby river. This resulted in widespread metal and arsenic contamination in the river basin dominated by agricultural land and threatened the Doñana National Park. A dam failure at the Baia Mare mine (Romania) in 2000 caused cyanide-contaminated water to spill over farmlands and into the river system. The polluted waters also reached Hungary and Serbia, killing large quantities of fish in the Tisza and Danube rivers. A dam of a toxic red sludge reservoir in Ajka (Hungary) ruptured in 2010. Red sludge or mud, a by-product of refining bauxite into alumina flooded in the surrounding territory resulting in a significant damage to the ecosystems and social structures of the region. At the Talvivaara mine (Finland), the leakage of waste water including nickel, uranium and other toxic metals ran into the nearby waterways in 2012, causing increased metal contents in lakes and rivers within several kilometres from the mining site.

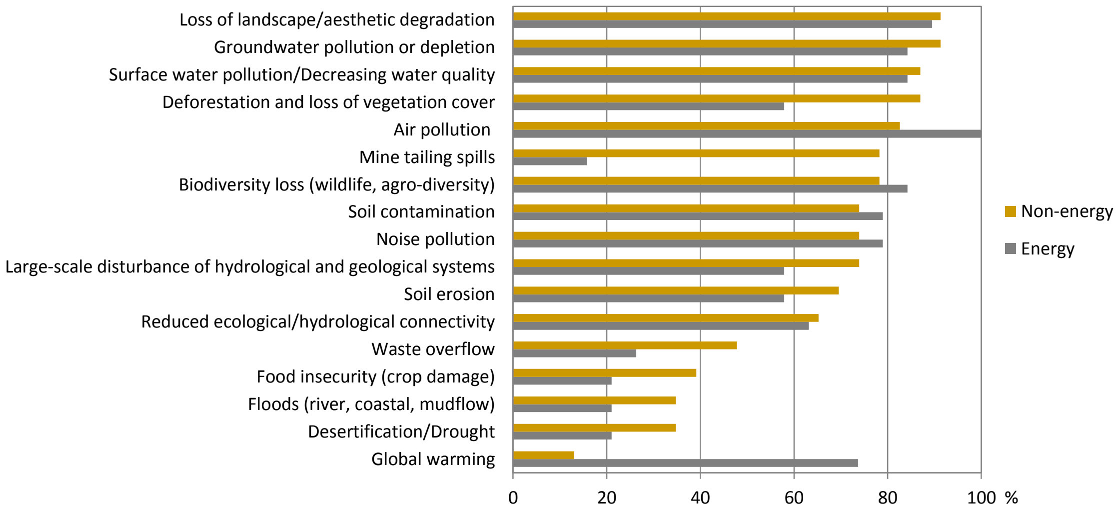

Fig. 3. Environmental concerns related to non-energy and energy mining conflicts.

The Mezica Valley in Serbia is an example of the area, where a long tradition in mining and processing of lead has caused significant environmental pollution with lead, zinc and cadmium, and a latent environmental conflict during the post-mining phase. Also poorly managed radioactive waste and uranium-related hazards were one important factor contributing to mining conflicts. Abandoned, non-rehabilitated uranium mines in Portugal are a good example of the mining impacts that potentially can continue over extended time during the post-mining period.

One distinct conflict-causing group was coal/lignite mines, a vast majority of these conflicts reported in the EJAtlas located in Germany and the United Kingdom. These mines are typically large in size, and cause concern on declined air quality and contribution to global warming in addition to other environmental impacts.

Socio-economic and health concerns

In addition to environmental impacts, mining was also resisted because of its adverse socio-economic impacts and health concerns (Fig. 4). The most important concerns related to more than 60% of the non-energy and energy mining conflicts were land disposession, loss of landscape/sense of place, displacement and loss of (current) livelihood. For example, huge coal/lignite mining projects in Germany, the largest lignite producer in the world, have resulted in resettlement of tens of villages and thousands of inhabitants. Loss of livelihood is often related to loss of agricultural land and forests, or declined values of the area for tourism (e.g. gold mining in Balkan, metals mining in Fennoscandia). Other concerns were related to, for instance, increase in corruption, loss of traditional knowledge, practices and cultures, and various other instabilities arising from major changes in the socio-economic structure regionally.

Mining resistance was also related to the concerns on health of either mining workers or local inhabitants. Exposure to unknown or uncertain complex risks, accidents, occupational diseases and environment-related diseases were mentioned in more than half of the non-energy and/or energy mining conflicts.

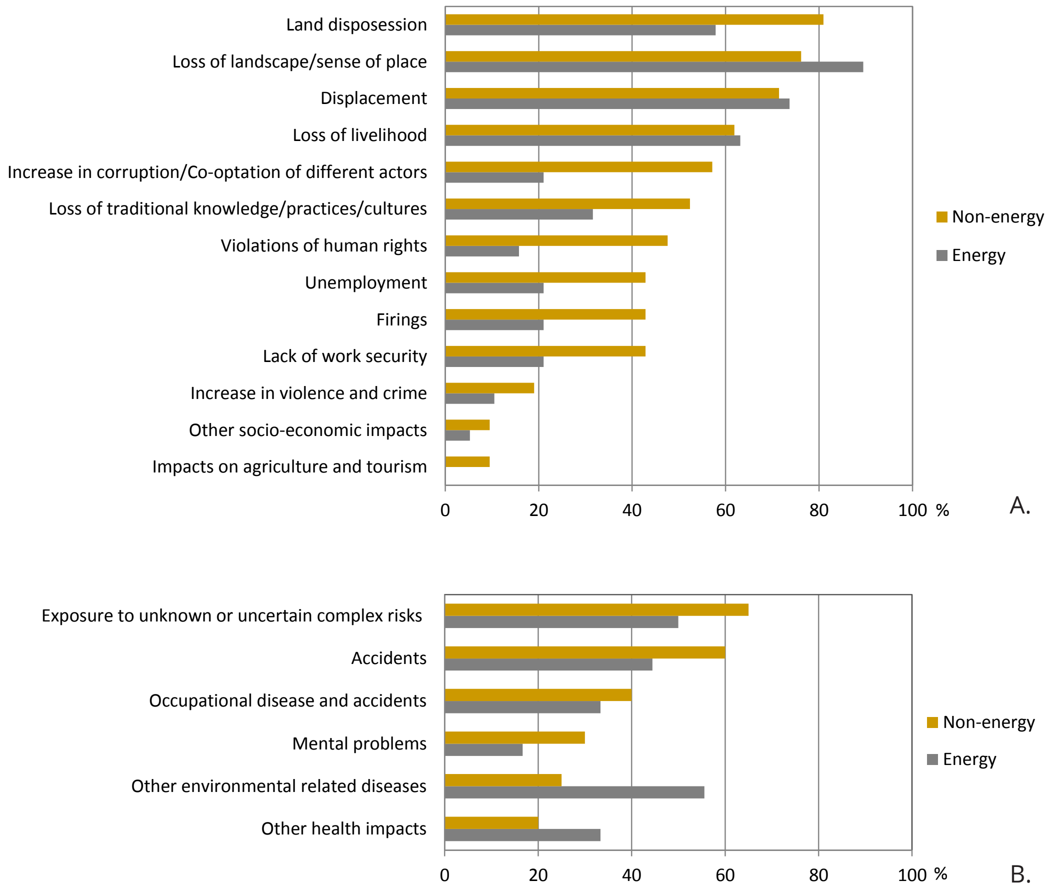

Fig. 4. a) Socio-economic concerns and b) health concerns related to non-energy and energy mining conflicts.

Conflict intensity, mobilizing groups and forms of mobilization

Approximately 14% of the cases were high-intensity conflicts, 54% medium-intensity, and 21% were low-intensity conflicts (Fig. 5). High-intensity conflicts were characterized by widespread resistance, mass mobilization, violence and arrests, whereas medium-intensity conflicts included for example street protests and visible mobilization. Low-intensity conflicts contained some local organizing. Approximately 12% of the conflicts were latent conflicts with no visible organizing at the moment. High-intensity and latent conflicts were more typical in the case of non-energy commodities and medium-intensity conflicts more typical in the case of energy commodities.

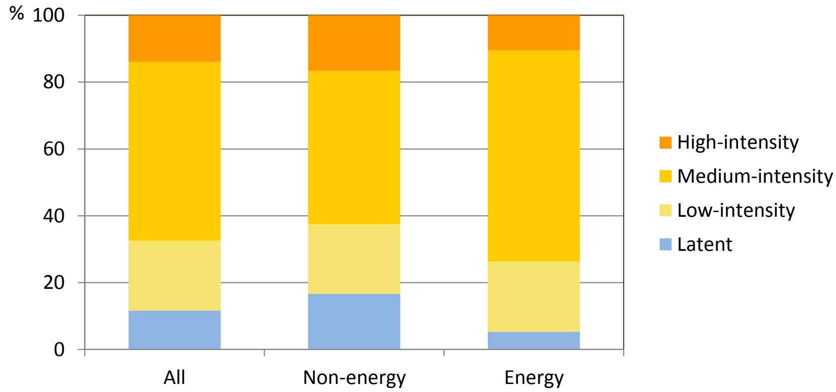

Fig. 5. The proportion of mining conflicts in the different conflict intensity classes.

The most important mobilizing groups were neighbours of the mining sites, citizens and communities, local environmental justice organizations (EJOs) and social movements (47–89% of the non-energy and energy mining conflicts) (Table 3). Local scientists, professionals and farmers were often involved in non-energy conflicts, and local governments and political parties and international environmental justice organizations in energy conflicts.

The most important actions that the movements took were the mobilization of national and international NGOs into the conflict, lawsuits, court cases, judicial activism, public campaigns, official complaint letters and petitions, and media-based activism/alternative media (53–78 % of the non-energy and energy mining conflicts) (Table 4).

Table 3. Mobilizing groups in non-energy and energy conflicts reported in the EJAtlas. The most frequently occurring mobilizing groups (≥ 50% of the conflict cases) are marked in bold.

Mobilizing groups	Non-energy (%)	Energy (%)
Neighbours/citizens/communities	**86**	**89**
Local EJOs	**73**	**79**
Social movements	**59**	**47**
Local government/political parties	32	**68**
International EJOs	32	47
Local scientists/professionals	**50**	26
Farmers	41	32
Indigenous groups or traditional communities	23	0
Recreational users	18	0
Fisher people	14	0
Industrial workers	5	11
Artisanal miners	5	5
Trade unions	5	5
Women	5	5
Ethnically/racially discriminated groups	5	0
Political Organizations; Grassroots	5	0
Landless peasants	5	0
Informal workers	5	0
Ex-miners	0	5

Table 4. Forms of mobilization in non-energy and energy conflicts reported in the EJAtlas. The most frequently occurring forms of mobilization (≥ 50% of cases) are marked in bold.

Forms of mobilization	Non-energy (%)	Energy (%)
Involvement of national and international NGOs	**74**	**63**
Lawsuits, court cases, judicial activism	**78**	**53**
Public campaigns	**70**	**63**
Official complaint letters and petitions	**70**	**53**
Media based activism/alternative media	**70**	42
Development of a network/collective action	**57**	47
Creation of alternative reports/knowledge	**57**	42
Street protest/marches	30	47
Objections to the EIA	43	16
Development of alternative proposals	22	26
Blockades	13	37
Referendum other local consultations	13	32
Appeals/recourse to economic valuation of the environment	26	16
Occupation of buildings/public spaces	9	26
Land occupation	4	32
Community-based participative research	9	11
Artistic and creative actions	4	16
Arguments for the rights of mother nature	9	5
Strikes	4	5
Refusal of compensation	9	0
Shareholder/financial activism	9	0
Boycotts or non-participation in official processes	0	11
Protest camps/tree-housing	0	5
Human chain	0	5
Sabotage	0	11

Causes of conflicts and a way forward

Europe hosts an outstanding diversity of physical and human environments, and mining activities are located in a wide variety of biogeographical, socio-economic and cultural regions. A vast majority of the mining conflicts reported in the EJAtlas took place in northern, eastern and southern (border) regions of Europe. Today, traditional mining is probably untenable in many densely populated European core areas. This has resulted in increasing mining development in peripheral areas, where there is smaller concentration of population.

During the recent years, mineral potential exploration in the European Union has been carried out especially in Sweden and Finland, and to a lesser extent also in other countries, such as Ireland, Portugal, Spain and Bulgaria (Euromines 2012; Lusty & Gunn 2015). For example, there are regions in Sweden and Finland which have started to put effort on becoming lucrative targets for investments by mining corporations. According to the Fraser Institute's annual survey of mining and exploration companies, Finland, Ireland, Northern Ireland and Sweden were rated among top 10 ranked jurisdictions based on the Policy Perception Index (PPI), which is a composite index that measures the overall policy attractiveness of the jurisdictions (Stedman & Green 2018). At the same time, conflicts between local communities and the mining sector are increasing in Europe similarly to other parts of the world (Andrews *et al*. 2017; Conde & LeBillon 2017; Velicu 2019; Zachrisson & Lindahl 2019).

Globally, mining conflicts are related to the distribution of burdens and benefits of environmental risks, rights related to environmental conservation, preservation of cultural integrity, indigenous rights and moral issues, and participation in decision-making concerning local development and environmental issues (Özkaynak & Rodriguez-Labajos 2017). Our results showed that recent mining conflicts in Europe arise from a wide variety of environmental, socio-economic and health concerns. The cases reported in the EJAtlas showed that many mining projects in the EU were resisted during the planning phase. This is because communities have learnt through the earlier cases of the impacts mining can cause to their environment and livelihoods, and because of plenty of uncertainties related to the impacts and risks of the projects (Conde & Le Billon 2017; Kivinen *et al*. 2018). Resistance to on-going mining projects also occurred when impacts, such as long-term pollution or environmental accidents, were felt.

Indeed, environmental impacts and hazards can occur during each phase of the life cycle of a mine from exploration to the post-mining phase. Some of these impacts are relatively easy to delineate and predict, for example the construction of a new open-pit mine causes local land transformations, such as deforestation, loss of other natural vegetation cover or loss of farmland. Instead, the indirect impacts of land transformations for example on ecosystems and biodiversity, and on the other land uses, businesses and livelihoods in the surrounding areas are more difficult to measure or estimate. Furthermore, some impacts of mining can be observed only after relatively long time periods, such as accumulation of heavy metals in terrestrial and aquatic environments, and long-term health impacts to miners and surrounding communities (Pereira *et al*. 2014; Baeten *et al*. 2018; Salom & Kivinen 2019).

Each mining location, and thus mining conflict, is unique in terms of the physical environment and socio-cultural, historical, political and economic background (Badera 2014). The cases reported in the EJAtlas showed that there was a great diversity of mobilizing stakeholder groups involved with the conflicts. The actions of local communities and social movements included for instance the mobilization of national and international NGOs, legal actions, public campaigns, petitions, demonstrations and media-based activism. The proportion of medium-to-high intensity conflicts including visible mobilization or widespread mass mobilization in the EU countries were slightly smaller compared to the corresponding global proportion reported in the EJAtlas (68% and 75%, respectively, see Özkaynak *et al*. 2015). Further, the proportion of conflicts related to energy minerals within the European Union was notably larger (41%; metals 46%; industrial minerals 13%) compared to the global proportion of energy minerals conflicts (19%; metals 75%; industrial minerals 6%) (Özkaynak *et al*. 2015).

A major part of the non-energy metal conflicts was related to gold mining. Gold mining activities have expanded particularly in the Balkan countries during the past decade. Currently about 90% of the significant gold producing operations worldwide utilize cyanide for gold and silver extraction (Mudder & Botz 2004). Cyanide is toxic to many living organisms at very low concentrations, and fish and aquatic invertebrates are particularly sensitive to cyanide exposure (Eisler & Wiemeyer 2004). Dam failures in metal mines resulting in large-scale pollution by toxic substances (Grimalt *et al*. 1999; Cunningham 2005; Mayes *et al*. 2011; Leppänen *et al*. 2017; Sairinen *et al*. 2017) have intensified anti-mining protests and protests against cyanide use in mining in Europe (Vesalon & Creţan 2013). For example, in the case of a planned gold mine Ada Tepe, the mining company needed to remove a cyanide-based method from the investment proposal because of strong resistance by the local communities and the municipal administration (EJAtlas 2019).

Compared to non-energy mining conflicts, energy mining conflicts were more characterized by concerns on air pollution and related health impacts in the surrounding communities, and global warming. Coal has remained a key component in the energy mix of several regions in European countries, while the European Union is committed to drastically reducing its carbon emissions. Coal (hard coal and lignite) is currently mined in 12 EU countries, of which Poland hosts the largest number of coal mines, followed by Spain, Germany and Bulgaria. The declining use of coal has led to mine closures in many regions across Europe (Johnstone & Hielscher 2017; Alves Dias *et al*. 2018). Coal mine closures have engendered debates on successful mine reclamation practices, future land use and socio-economic development in these areas (Wirth *et al*. 2012; Alves Dias *et al*. 2018).

Earlier, mines were often abandoned in Europe and other part of the world without considering potential risks to humans and the environment (Fields 2003; Kivinen 2017). Prior to granting a mining permit, most regulatory agencies today require mine closure and reclamation plans aiming at ensuring public safety, minimizing potential negative environmental impacts and allowing alternative land use opportunities (Heikkinen *et al*. 2008; Revuelta 2017). The Mining Waste Directive (2006/21/EC) prompted by accidents in Spain and Romania introduces measures for safe management of waste resulting from the extraction, treatment and storage of mineral resources and the working of quarries. EU member states are currently required to draw up and periodically update an inventory of closed waste facilities on their territory including abandoned facilities, which cause serious negative environmental impacts or have the potential of becoming a threat to human health or the environment. Over 3,400 closed and abandoned waste facilities were registered in 18 national inventories (as of July 2017) (European Commission 2017b). There is also current research on the EU level how innovation processes in the waste management and mine closure are functioning and how they are supported or inhibited by national and European policy and legislation (Politis *et al*. 2017). However, already closed or abandoned mines remain problematic due to financial and legal liability issues and the need to be addressed predominantly on a national basis. In the case of uranium mines in Portugal reported in the EJAtlas, emerging concerns of the local populations and the results of the environmental surveys led the government to decide on an public health assessment and environmental remediation of abandoned sites (Pereira *et al*. 2014).

Resistance to mining in local communities arises often from potential or observed environmental impacts, but also from the lack of representation and participation, lack of monetary compensation and distrust of the mining company and the state (Conde 2017; Conde & Le Billon 2017). The results of Zachrisson and Lindahl (2019) suggest that mining resistance grows at the national level when mining-sceptical actors are offered little or no real access nor influence by the state in either policy formulation or implementation, that is, the actual licensing processes. Thus, effective communication with communities and genuine community participation should play a vital role in the governance related to large-scale extractive operations (Hilson 2002; Schilling *et al*. 2018). According to Peltonen and Sairinen (2010), social impact assessment of land use plans can contribute to conflict management, and may acquire features of conflict mediation, depending on the extent and intensity of stakeholder participation. More attention should also be paid to public participation and justice concerns associated with reclamation of mine sites (Kivinen *et al*. 2018; Beckett & Keeling 2019). Beckett and Keeling (2019) suggest that mine remediation should not only focus on technical management, but also the contested political, social, and cultural relations generated by the extraction and its legacies.

The EJAtlas data provides a unique tool for examining socio-environmental conflicts at regional and global scales. The EJAtlas is constantly expanding, as new cases are added to the database by activists and collaborators. A major limitation of the EJAtlas is the geographically biased distribution of reported conflict cases and lack of data on some regions. However, compared to an examination of conflicts only through case studies, the wider geographical focus can help to achieve a more holistic picture of the conflicts and their drivers (Özkaynak & Rodriguez-Labajos 2017). Ultimately, the results may decrease the power imbalances between different stakeholder groups and the mining industry.

Conclusions

By reviewing existing and recent conflicts over mining activities within the territory of the European Union, this paper makes an attempt to illustrate the variety of challenges there are at a local scale as the institutions of the European Union are putting forth political programmes on increasing mining in Europe. The aim of this paper has also been to show that an attempted increase in the number of mining projects at the scale of the European Union runs the risk of the projects being faced by strong activism against the increase in mining. The probability for such protests is visible across Europe. The variety of causes of conflict is wide and ranges from environmental impacts to socio-economic and health concerns of the populations residing in the vicinity of the mines.

A conclusion can be drawn from these findings that when designing the policies on increasing mining, the policy makers should also increasingly pay attention to the multiple impacts that mining has had on the environment and socially, in order to be able to put the plans for increasing minerals extraction in Europe into practice. The policies that have been drafted on the level of the European Commission have pointed out that it is unlikely that mining could be increased in large quantities in the densely populated areas of Europe. Therefore, it is likely that the intensification in mining in the future would concentrate on the peripheral and more sparsely populates areas in Europe, in contrast to many of the earlier mining areas in the highly populated areas. However, the analysis of the data in the database reviewed in this paper proves that protest against mining would probably grow in these peripheral regions as well. Furthermore, while mining conflicts have arisen during all the phases of the life cycle of a mine, from the exploration of mineral resources to the post-mining phase of mining, new mining projects have been well presented amongst conflicts against mining. Clearly, the plans for increasing mining in Europe by starting new mining projects would be faced with this challenge.

Notes

[1]The most recent list includes antimony, beryllium, borates, cobalt, coking coal, fluorspar, gallium, germanium, indium, magnesium, natural graphite, niobium, phosphate rock, silicon metal, tungsten, platinum group metals, light rare earths and heavy rare earths, baryte, bismuth, hafnium, helium, natural rubber, phosphorus, scandium, tantalum, and vanadium.

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