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Canadian mines, global issues: examining health impacts, demanding action

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Abstract

Background While a global player in the mining and metals sector, there is little regulatory oversight by Canada of Canadian mining companies in relation to their transnational activities. Much mineral exploration and mining take place in remote and rural areas inhabited by Indigenous and other minoritized and/or marginalized communities, and has been linked to worsening health, social, and environmental conditions. Few effective legal mechanisms exist to monitor, investigate, and provide effective remedies for their harmful impacts.

Methods Three focal mining communities representing different mining life stages were studied: exploratory phase (Philippines), midlife (Brazil), and a transitioning to end-stage that has now been reinvigorated post-nationalization (Kyrgyz Republic). A qualitative approach based on locale-specific community consultations was employed with analysis informed by a theoretical framework based on the commercial, political, and social determinants of health, environmental justice, and their interactive and embodied impacts.

Results and discussion The community consultations yielded the following notable findings: a failure to acknowledge Indigenous rights (all sites); intimidation and harassment of local residents raising objections (Brazil and Philippines); the centrality of mines entrench social and economic inequities—including pre-existing ones (all sites); prior experience and knowledge of harms linked to extractive resource industries affect perception and resistance to mines (Brazil and Philippines) and the presence of widespread illness and disease among miners (Brazil and Kyrgyz Republic). Participants expressed support for community-driven mining and health studies documenting long-term occupational and environmental health impacts, particularly respiratory and water-borne illnesses.

Conclusions Despite the lethargy, obfuscation, and refusal of the Canadian government to take action on the global interests and actions of its corporations operating abroad, local efforts to resist the experienced and potential harms of transnational Canadian mining operations are noteworthy. Canada must comply with its binding international human rights obligations and move beyond its failed policy approach to addressing the harmful impacts of these endeavours. Future research must be conducted with and be accountable to local communities.

Clinical trial number Not applicable.

Keywords Commercial determinants of health, Political determinants of health, Mining, Environmental justice, Canada, Brazil, Kyrgyz Republic, Philippines

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Introduction

Canada is a global powerhouse in the mining and metals sector and is host to approximately “half of the world’s publicly listed mining and exploration companies,” with 761 of such companies operating abroad in over 95 countries [1]. With international mining assets valued at \$220.4 billion, Canadian mining operations contributed \$117 billion to Canada’s GDP in 2023 [2]. While the economic benefits of mining operations serve fiscal, corporate, and government interests, mining activity also has detrimental environmental, human rights, health, and other negative social impacts. Much mineral exploration and mining take place in remote and rural areas inhabited by Indigenous and other minoritized and/or marginalized communities, and has been linked to worsening health, social, and environmental conditions [3–7]. For example, mines in northern Canada have a poor record of remediation by focusing on technical aspects of clean-up and not working with Indigenous communities to return the land to a safe and accessible or familiar landscape [8–10].

Canadian companies operating abroad have been implicated in a wide range of human rights violations, including allegations ranging from war crimes [11], forced labour and torture [12], forced displacement and extrajudicial killing [13], gang rape and murder [14, 15], to death threats and environmental harm causing health impacts. The Justice and Corporate Accountability Project (JCAP) has documented over 400 incidences of violence associated with Canadian extractive operations in Latin America [16]. Moreover, there are instances where the Canadian government failed to act to protect human rights defenders who were protesting Canadian transnational mining operations [17]. There have been growing calls over two decades from civil society actors, international human rights treaty bodies, and Canadian parliamentary committees for Canada to regulate its mining companies operating abroad and provide effective remedies for victims of corporate-related human rights violations [18]. Yet there is little regulatory oversight by Canada of Canadian mining companies in relation to their transnational activities and few effective legal mechanisms exist to monitor, investigate, and provide effective remedies for their harmful impacts [18–20]. Moreover, in comparison with social and environmental responsibility standards for mining activity in Canada, there is a paucity of evidence-based practices that monitor and report on health and social outcomes in relation to Canadian mining activity abroad [21].

Beyond Canada’s position, a global governance gap persists with respect to transnational mining activities, which adversely affects human rights and enables environmental harms [22]. While transnational corporations (TNCs) are prohibited from committing international

crimes, disputes continue about obligations of TNCs to respect human rights [23]. Moreover, many host states, particularly in the global South, may be unwilling or unable to effectively regulate foreign TNCs [24]. These factors, along with other structural aspects of the international legal system, enable TNCs to often operate with impunity, unaccountable for the human rights violations and environmental harm that they have caused or to which they have contributed [24]. Responsible business conduct¹ (RBC) policies and practices are increasingly seen as contributing to a firm’s ability to obtain “social licence,” or consent of local communities to reduce the risk of social opposition to their plans [25–27]. RBC practices, such as meaningful community consultations, engaging in ongoing human rights and environmental due diligence, participatory environmental monitoring, and local development projects can positively affect local perceptions of the consequences of mining investment [28]; however, the quality of community engagement varies greatly, and meaningful consultation that responds to the concerns of community groups is rarely attained [27, 29–31].

This context provided the impetus for our exploratory examination of the environmentally determined health and social impacts of Canadian transnational mining practices on three focal communities in the Philippines, Brazil, and the Kyrgyz Republic. We respond to Birn et al.’s 2018 [32] call to Canada’s public and global health communities to acknowledge our “special ethical and political responsibility to act to reverse the harms associated with Canadian mining activities in Latin America and beyond through advocacy, research, and using their public voice.”

These countries and locales were selected firstly because the principal investigator had long-standing research interests and relationships in each location that facilitated the needed network- and trust-building with local Indigenous and ethnically marginalized communities where these mines were situated. Secondly, mines in these locales represented three different ‘life stages’ of their respective mining operations, which we anticipated would render disparate responses and concerns. To present our arguments, we begin with an overview of the theoretical lenses and methodologies that inform our work and describe our methods. Thereafter, we offer a snapshot of the mine and focal community along with the results of our community consultations. In the discussion we bring our findings into conversation with our theoretical lenses and highlight resistance to Canadian mines, concluding with our call for action.

Theoretical lens, methodology, and methods

Our theoretical lens is informed by commercial, political, and social determinants of health, environmental justice, and their interactive and embodied impacts that are felt, responded to, and (potentially) resisted by individual and collectivities of bodies.

Commercial, political, and social determinants of health

Commercial determinants of health (CDH) can be broadly defined as the “systems, practices, and pathways through which commercial acts drive health and equity” [33]. CDH encompass not just the development, production, and marketing of unhealthy products by commercial actors, but also the economic underpinnings of neoliberal global capitalism that contour the actions of corporations [34–36]. Corporate entities are allocated various rights and privileges by state authorities in their quest to maximize profits for shareholders [33]. To this end, corporations engage in a host of strategies to persuade policymakers, media influencers, others who are key to their pursuits (e.g., scientists, community and religious leaders), and consumers to adopt policies, practices, discourses, and governance mechanisms that are favourable to their interests [33, 36]. The effects of corporate power and influence are manifest in often disequalizing and exploitative forms of employment and harmful working conditions, and in enforceable international trade and investment rules that benefit private profit and wealth accumulation by a small number of billionaire investors. The health effects of climate change, increased spread and distribution of disease, toxic contamination of ecosystems, and creation of social harms are externalized as public costs, with often only weak efforts to control and mitigate these effects [33, 35, 36].

Conjoined with the CDH, the political determinants of health (PDH) draw specific attention to global capitalism and issues of power—agentic, structural, and discursive—as central to outcomes of health and wellbeing [35, 36]. Whether through the structuring of relationships, hierarchies, and the distribution of resources and power, PDH work to facilitate or undermine health equity [36]. Notably, PDH, by focusing on global capitalism and political economy, place governance structures including treaty dispute mechanisms and investment treaties as important areas for analysis as potential means to address tensions between market and nonmarket actors and to offer an upstream target for critique and collective action [35, 36]. Persaud, et al. [37] propose an additional spatial and multi-scalar lens that links international, national, regional, and local level policies, relationships, and distribution of assets in their articulation of a geopolitical determinants of health framework.

Social determinants of health (SDH), the upstream, non-biomedical elements including sociopolitical

systems, policies, and norms that shape the health conditions in which people live, gained considerable public health and policy traction through the World Health Organization (WHO)'s 2008 Commission on Social Determinants of Health [35, 38]. Although the Commission report asserted that social injustice contributed to excess mortality, SDH as a normative concept has been critiqued for failing to offer a cogent political analysis as to who benefits from perpetuating inequities and the role that those interests play in shaping biomedical concepts and health care [35, 38]. Moreover, SDH has been increasingly depoliticized in studies that focus on their role in influencing individual behaviours and interpreted through the language of risk rather than naming the structural forces that shape inequities [39]. ‘Structural’ or ‘societal’ are increasingly used to replace ‘social’ in identifying ‘determinants of health’ in an effort to overcome the depoliticized ‘risk factor’ tendency and to ensure that analysis extends to the socioeconomic drivers of such determinants.

Environmental justice and the social distribution of harm

Canadian transnational mining is a major Canadian and global issue that yields an uneven distribution of harms and benefits to the detriment of existing communities that are often historically marginalized and vulnerabilized, and consist of minority or Indigenous groups. Forces at play include resource depletion, environmental degradation, violation of Indigenous rights, health impacts, and social consequences. These are compounded by inadequate policy and legal responses including regulatory mechanisms for Canadian companies operating mines abroad. A useful field of study in this context, environmental justice, is defined as the academic study and practice of combatting the disproportionate presence of environmental pollution and resulting health risk in areas with high percentages of low-income residents and racialized minorities [40].

While communities have struggled to mitigate adverse impacts, more academic investigations are needed that examine environmental justice in connection with transnational mining endeavours, and in more nuanced or granular ways. For example, mercury exposure stemming from gold extraction is a global phenomenon and has been comprehensively studied; however, comparisons with other extractive endeavours are limited given its artisanal and decentralized nature. Another case where the environmental justice impacts of extraction processes have been described entail investigations of mountain top removal associated with coal in the USA. Studies have found that this activity is concentrated in socioeconomically disadvantaged regions of Appalachia, and produces extensive environmental contamination stemming from the release of particulate matter (PM),

silica, polycyclic aromatic hydrocarbons (PAHs), and metals [41]. Moreover, the impacts are not limited to the extraction sites but also to the undesirable locations produced by the removal activities, as evidenced in the high poverty rates found in Appalachian neighbourhoods—an effect that persists after the reduction or cessation of mining activities [42]. From a global perspective, potential environmental justice impacts to populations in proximity to transnational mining operations extend to inequities related to community displacement [43], ecological and biodiversity impacts [44], water degradation, soil degradation, and loss of landscape [45]. Importantly, these differences can persist beyond the mine's lifetime and remediation. Given Canada's prominence in the global mining industry, setting the stage for movement towards greater environmental sustainability and community health and wellbeing requires documenting and sharing the impact of mining operations to stakeholders and policy makers.

The body and embodiment

The interconnections amongst the health determinants we have outlined are felt and animated by considerations of the body and embodiment. As the entity through which we apprehend the world, the body is situated in social location and is the site in which we take in and interpret encounters with our life world [46]. The fluid and interpenetrating interactions between macro-level political economic context including global capitalism, neoliberal globalization, and the legacy of colonialism and neocolonialism, intersecting with meso-level institutions—gender ideologies, gendered division of labour, policies, trade agreements, health and social care—and micro-level organizations of the community, household, and family are ultimately experienced in and through the body [47]. This embodied process results in the production of signs and symptoms that are discernable as disease or injury or may appear inchoate (although intelligible to others with shared experience) and, if the result of inequity and oppression, read as the embodiment of inequality [48]. Notably, the body and collections of bodies can be potent sites of resistance and collective action [49].

In sum, our intersecting theoretical lenses enable us to attend to the multi-scalar environmental and socio-political processes that unevenly distribute harms and benefits to populations who reside near and are potentially employed by Canadian mining companies globally.

Methodology and methods

To capture the complex and multi-scalar issues that are implicated in understanding the effects of Canadian mining on a focal community in three countries, we selected a cross-case mixed methods design that gathers a variety

of data that could allow for different scales of analyses [50, 51]. Cross-case design involves multiple detailed descriptive and exploratory examinations of a single issue (case) in situ primarily using mixed methods [48]. This methodology follows Freudenberg's [35, 39] exhortation to integrate the voices and perspectives of a range of interlocutors alongside other data sources and analyses grounded in particular locales to address and redress the impacts of neoliberalism and global capitalism. Moreover, both our internal processes and our interactions with communities and other interlocutors were grounded in feminist and decolonizing methodologies that attend to questions of diversity, power, and oppression [52].

Case studies and community-responsive methods

After obtaining ethics approval from the principal investigator's academic institution, the University of Alberta, we worked with local community and academic partners to determine the parameters of respectful engagement that would be anchored in community consultations. Consultations involved Indigenous and other community leaders, community organizers, local government and non-governmental organization representatives, mine workers, and affected residents depending on the site. These engagements informed the refinement of research questions, the prioritization of health and environmental concerns, and decisions regarding data interpretation and dissemination. Methods were locally determined in consultation with community partners to ensure cultural appropriateness, political feasibility, and participant safety. These variations resulted in distinctive research processes across sites in reflection of our commitment to community-responsiveness and context-specific methodologies.

Our Philippine case study began with engagement with long-standing community partners and civil society organizations in the Cordillera to determine whether the research would be useful and safe for community members. Their input guided our selection and approach that was also informed by the context of the historical marginalization of Indigenous communities, state-corporate alliances, gendered leadership and resistance, intra-community divisions, and legal intimidation and violence. To avoid comparison with performative consultations imposed by mining companies, ours were framed as collective reflection sessions where community members could narrate their own histories of resistance, identify health concerns, and articulate research priorities. Working to ensure inclusion of a diversity of voices across age and gendered social location, participants in focus group discussions and key informant interviews included Indigenous community leaders, women leaders, representatives from civil society and Indigenous organizations, and local government officials. Returning to the communities

to share preliminary interpretations allowed the team to further integrate local priorities and understandings into our findings, underscoring our commitment to ethical and inclusive work.

For the case of a mine in midlife, the local Brazilian team worked in Paracatu in the state of Minas Gerais, making initial contact with a trio of representatives from charitable religious, advocacy, and activist backgrounds. These individuals further facilitated introductions to Quilombola community members who had a long history of grassroots resistance to gold mining impacts. Foremost, the team had to navigate community members' initial reluctance to engage with them as previous research efforts had little to no impact in addressing their concerns. Moreover, the perceived omnipresence of the corporation that could impact employability and affect interpersonal relationships contributed to a pervasive unwillingness to express their concerns. The team engendered trust by spending time listening to community members who recounted the communal disruptions and dislocations effected by the Canadian Kinross mine. They were then invited to witness the mine's health and environmental impacts on the local community. Issues raised in these interactions informed both the questions posed in data collection and the choice of using one-on-one interviews with local residents and Quilombola community leaders in their choice of private settings.

For the transitioning to end-stage mining operation In the Kyrgyz Republic, the Kyrgyz research team carried out preliminary meetings with village leaders, local health post workers, and former miners in Barskoon and surrounding communities. These consultations sought guidance on appropriate venues for discussions, optimal timing considering agricultural seasons and work schedules, culturally acceptable approaches to discussing sensitive health topics, and community preferences regarding group versus individual discussions. Based on this input, focus groups were stratified by employment status (current Kumtor employees, former miners, and community members without direct mine employment) to avoid power dynamics and potential intimidation within mixed groups. Interviews were conducted in homes or village health posts rather than formal institutional settings, reflecting local preferences for familiar environments when discussing sensitive health matters. The team also incorporated Kyrgyz-language terms for environmental phenomena (particularly glacier-related vocabulary) and illness descriptions that reflected local understandings rather than imposing biomedical terminology. Following initial analysis, the team returned to community members to present preliminary findings and solicit feedback on interpretation, leading to refinement of our understanding, particularly regarding the embodied health effects described by participants.

Findings

Exploratory phase: Solfotara, the Philippines

The Philippines is the fifth most mineral-rich country in the world, and mining is among its oldest industries [53, 54]. The Mining Act of 1995 facilitated foreign investment in Filipino resource development by offering financial and administrative incentives [6]. Located in northern Luzon, the Cordillera has been a central location for the Philippine extractive endeavours due to its topography and wealth of mineral deposits. A minimum of six Canadian companies own an estimated 15% of mining operations in the Philippines, including Oceana Gold Didipio Mine, Placer Dome, and Toronto Ventures Resource Development, Inc [55]. Canadian business interests collectively possess a total of more than 40,000 hectares of active mineral claims [56]. The Cordillera Peoples Alliance (a civil society network) states that Canadian and Philippine company partnerships, such as Ivanhoe and Lepanto, have been associated with intense environmental degradation including pollution of the Abra River, an important source of water for downstream farming communities [57].

The collapse of tailings dams that hold mine wastes and toxic chemicals of mining operations in the region has poisoned water sources and agricultural lands, affecting the health and well-being of Indigenous communities as well as residents of nearby low-lying provinces [58]. In this backdrop, the Canadian mining company Solfotara is developing porphyry copper mine sites near Bokod and Kibungan in the Province of Benguet on the northern island of Luzon. Half of all areas targeted by mining companies in the Philippines are subject to Indigenous land claims [6]. Although the 1997 Indigenous Peoples' Rights Act (IPRA) mandates the free, prior, and informed consent (FPIC) of affected Indigenous communities before mining activities can proceed, this process is often disregarded by companies, with violations overlooked by corrupt authorities [59, 60]. As Olea and Barry [61] have shown in their case study of the Kalinga people, FPIC processes are frequently manipulated or bypassed altogether, reducing consultation to a mere performance that serves extractive interests. Similarly, Holden et al. [62] have documented how transnational mining corporations operating in the Philippines rely on legal loopholes, state collusion, and CSR narratives to suppress resistance and accelerate extraction. These findings are echoed in a comprehensive report by the Tebtebba Foundation [63], which documents widespread FPIC violations, intimidation, and militarization in mining-affected Indigenous communities across Luzon and Mindanao. The Cordillera Peoples Alliance states that 276 mineral claims, amounting to about 746,968 hectares, cover Indigenous Igorot lands that are legally designated ancestral domains [64]. Despite constitutional safeguards and the IPRA of

1997 requiring free, prior, and informed consent, existing studies and advocacy reports describe the routine disregard of these provisions that are frequently accompanied by militarization and intimidation of the affected communities [57, 58]. Numerous studies—including recent field-based work by Veridiano and Holden [65]—have shown that extractive firms routinely bypass FPIC, often with the tacit complicity of state institutions, exacerbating land dispossession and weakening Indigenous political autonomy.

Community consultations included six focus groups and key informant interviews with community organizers, local government officials, and Indigenous leaders who possessed profound knowledge of the history of mining in their locales. Importantly, their current interactions with and response to Canadian transnational corporations trying to develop mining projects in Bokod and Kibungan, Benguet province, are deeply informed by their past experiences with—and resistance to—previous extractive projects. Participants in our community consultations described a case involving Magellan Metals and Columbus Minerals that embarked on exploration in 2007 without rightful free prior and informed consent, recruiting local labourers and professing community acceptance. Similarly, they noted that Solfotara Mining Corporation and De Gama Minerals conducted consultations at Kibungan from 2006 but persisted with drilling operations at Palina village since 2010, despite rejection by the local people [66, 67]. These historic examples recounted by participants in our study support other research that affirms regional accounts of extractive intrusion through phony consultation, subversion of local governance, and pseudo-participation through performance of “corporate social responsibility” (CSR) [6, 62, 64].

As an exploratory-stage project, Solfotara’s activities have centered on drilling, geological surveys, and land access negotiations rather than full-scale extraction. Nevertheless, participants emphasized that even these early-stage activities have tangible social, environmental, and health implications. Community members described disruptions to water sources, restrictions on access to agricultural and grazing lands, and heightened anxiety stemming from uncertainty about future displacement and environmental degradation that generate high-levels of psychosocial stress that have their own negative health effects. Thus, even at the exploratory phase, environmental and psychosocial health impacts were evident.

Participants in our community consultations identified myriad health concerns that they attributed to environmental degradation and livelihood loss. Respiratory diseases amongst former miners, indicative of chronic occupational exposures, was of primary concern. Many community members shared ongoing fears that the loss

of agricultural land and water pollution due to mining will impact soil fertility and grazing grounds, and that eventually food insecurity will escalate and persist. Moreover, as health and culture are tied to land, the reduction in ancestral territory due to displacement and mining operations and subsequent threats to cultural unity, the passing on of intergenerational knowledge and practice of their lifeways, contributes to psychosocial stress. These lived circumstances capture the social and embodied determinants of health in extractive areas, where compromised food systems, toxic ecosystems, and cultural displacement intersect to multiply mental and physical health issues. Indigenous women are not only disproportionately affected by environmental degradation, but also serve as vital leaders in resistance efforts—drawing on spiritual knowledge, land-based identities, and care responsibilities to protect both health and sovereignty [67, 68]. As a participant noted, “When the river died, our strength also weakened”—providing a direct connection between environmental degradation and community wellness.

Mid-life phase: Kinross, Brazil

In 2004, Kinross Gold Corporation (KGC) became the sole owner of Brazil’s largest open-pit gold mine [69], positioning itself as the modern continuation of a mining industry that originated in the late 17th century. Located in Paracatu, in the State of Minas Gerais, this Canadian corporation is responsible for 22% of Brazil’s gold production, extracting an average of 17 tons per annum [70]. KGC profoundly shapes the municipality’s socioeconomic, environmental, and cultural profile [71]. Notably, at this site, one ton of rock is blasted to extract 0.4 gram of gold [72], a process that releases large amounts of arsenic. In Paracatu, arsenic concentration averaged 124 ppm across 45 sampling points—more than eight times the national reference value of 15 ppm, a phenomenon facilitated by the release of arsenopyrite associated with local gold exploration [73]. With a population of just over 99,000, 75% of Paracatu’s inhabitants are of non-European descent [74]. Among these residents are Quilombolas, descendants of Afro-Brazilian slaves. In Paracatu, the *Bandeirantes*—a private militia—forced thousands of them to work in gold mines for the benefit of the Portuguese Crown [75]. Quilombolas currently live in rural settlements, producing and consuming traditional agricultural products and foodstuffs. Meanwhile, they bear the consequences as arsenic contamination from gold mining in Paracatu has been linked to a range of deleterious health effects, including cardiovascular disease, cancer, skin lesions, and spontaneous abortions, according to specialists [76]. At a time when former President Jair Bolsonaro weakened environmental protections, Kinross continued to develop the mine on their claimed

territories, while the contestations over title to traditional lands continued to be litigated in the Brazilian courts [77].

In Paracatu, our community consultation and site visit revealed a range of complaints. Residents reported daily disturbances from loud rock blasting, mining dust, and foul smells. In addition, they identified arsenic contamination in the air, water, and soil, which they associated with chronic diseases, including chronic skin diseases and malignant neoplasias. These myriad problems contributed to a sharp decline in their property values, a situation they attributed to Kinross's lack of social responsibility. The result was that community members felt trapped. Near the blast sites, residents endured unbearable noise and watched cracks accumulate in their walls. Local community members decried what they perceived as intimidation, harassment, and co-optation of local community leaders by the mining company that generated a general atmosphere of distrust. This extended to external researchers as previous research projects were deemed to have failed in challenging corporate assertions about the impact of the Kinross mine on the environment and local community.

In particular, residents are haunted by the memory of Brumadinho's 2019 dam collapse, which killed 270 people and caused immense environmental devastation—a fear exacerbated by the fact that the two tailings' dams in Paracatu hold a waste volume a hundred times larger than those at the Brumadinho site [78, 79]. Resultantly, residents in Paracatu fear the rain due to the looming risk of a similar dam collapse. This existential threat is so acute that a 2021 false alarm activated by the Kinross Gold Corporation that warned of a (non-existent) dam collapse induced PTSD in many residents. Subsequently, an independent lawyer filed moral damage lawsuits on behalf of 165 families following that disruptive event.

Community members also expressed regret that the local union was limited to defending the professional rights of the approximately 1,800 employees who were directly hired by Kinross. The vast majority of the workforce, an estimated 4,000 persons who were deemed individual contractors were excluded from union membership and representation. Furthermore, they felt their complaints about the mine's operations and corporate behaviour were consistently met with denials or opaque responses from the company, which leverages its position as Paracatu's key employer [75] to shield itself from criticism. They also expressed cynicism about the KGC's reputed social responsibility initiatives that they viewed as empty publicity initiatives imposed on the community of Paracatu. For instance, without consulting the local community or its representatives, KGC built a sports centre that stood merely as a frequently empty and unused building. A final—and significant—issue in

Paracatu concerns the projected lifespan of the mining operation that is set to close in 2032, something that yet remains a tacitly taboo topic amongst employees. Given all these issues, some community members describe their fellow Paracatu residents as the “walking dead.”

Transitioning to end-stage, post-nationalization, and reinvigoration: Kyrgyz Republic

Centerra Gold's *Kumtor Gold Mine*, located 350 km southeast of the Kyrgyz capital, Bishkek, was a mine transitioning toward closure after more than two decades of operation. Having begun production in 1994, Kumtor is among the longest-running high-altitude mines globally and now faces pressures common to mines approaching end-stage: resource nationalism, unresolved legacy health claims, community anxieties about post-mining futures, and questions about permanent environmental damage [80, 81]. The mine employs about 3,000 Kyrgyz and contributed approximately \$4.14 billion USD to the economy from 1994 to 2019 [80]. Located at an extreme altitude (3,200–4,000 m above sea level) near pristine glacial systems, the mine represents the largest mining operation in the world that interferes with glaciers [81, 82]. Complex industrial factors affect the working conditions of miners at opencast mines in Kyrgyz Republic, who must simultaneously contend with extreme climatic and geographical conditions [4, 83, 84]. Further, the deleterious effects of the chemically complex ore at the site have been shown to worsen lung damage in workers [85–87].

While the most recently published epidemiological study of Kumtor workers found a 6.3x increase in dust bronchitis and rising occupational morbidity, from 0.38 in 1996–2000 to 0.61 per 1,000 workers in 2001–2005 [88], site-specific epidemiological data for recent years are not publicly available. This data gap itself reflects broader challenges in transnational mining accountability, where occupational health research in the Central Asian context is infrequently published in international journals, and data collected by companies or governmental agencies are often not publicly accessible. More broadly, recent occupational health research confirms that workers at high-altitude mines face elevated risks of cardiovascular disease, with a 2024 prospective cohort study documenting cardiovascular diagnoses leading to unfitness for work among miners at 4,000 m above sea level in the Kyrgyz Republic [89, 90]. In this context, community-reported health concerns, including cardiovascular disease, dermatological conditions, and respiratory illnesses, become essential sources of evidence, even as they cannot substitute for systematic epidemiological surveillance.

The environmental impacts of the Kumtor mine operations extend far beyond the immediate mining site, creating cascading effects on community health and regional

ecosystems [88]. Research on Central Asian mining operations documents myriad environmental impacts, including land degradation, biodiversity loss, dust generation, water pollution, and water depletion, which threaten the health and livelihoods of communities [91]. Concerns about environmental harms prompted the Kyrgyz government, which had a 26% stake in Kumtor, to nationalize the mine in May 2021 [92]. Currently operating with external management, Kumtor and the Kyrgyz government are discussing an out-of-court settlement of the dispute over the mine's nationalization [93, 94].

The trajectory of the Kumtor mine took a significant turn following its nationalization in May 2021 [92]. After a period of dispute, the Kyrgyz government and Centerra Gold reached an agreement in 2022, resulting in full state ownership of the mine [93, 94]. In a major development, initiated after conclusion of our research, the government launched a new underground mining operation at Kumtor in August 2025, marking a shift from its decades-long open-pit method. Kyrgyz President Sadyr Japarov announced that this underground project is expected to operate for 17 years and yield an additional 147 tonnes of gold, suggesting a potential operational lifespan of 40–50 more years [95]. This reinvigoration of the mine has complex implications for the themes of this paper. President Japarov publicly framed the shift to underground mining as environmentally superior, explicitly criticizing previous foreign operators for choosing “the cheaper and easier option of open-pit mining, destroying the glaciers in the process” [95]. This development, however, does not erase the community's longstanding grievances documented in our consultations. Instead, it adds a new layer of complexity: residents now face the prospect of a prolonged extractive presence, with continued concerns about glacial integrity, water security, and labour rights, now under a national operator. Furthermore, the political history of the mine remains fraught; the same president who championed nationalization was imprisoned for his role in related protests, and the first state-appointed director of the mine was later arrested on corruption charges [95]. This context underscores that a change in ownership does not automatically resolve the deep-seated issues of governance, transparency, and community health that have long defined the Kumtor mine.

Community consultations in Barskoon highlighted concerns that reflect Kumtor's transitional status. Unlike exploratory-phase communities that fear potential harm, or mid-life communities that negotiate daily disruptions, residents here confront the prospect of permanent environmental damage and unresolved legacies. An infamous 1998 cyanide spill represents a watershed moment in the community's relationship with Kumtor Gold Mine operations [94, 96, 97]. When a mining truck carrying cyanide crashed, releasing toxic materials into the Barskoon River

and ultimately into Issyk-Kul Lake, the incident demonstrated the catastrophic potential of mining operations in this sensitive ecosystem. The lasting impact of this disaster is evidenced by ongoing legal cases, with 24 Barskoon villagers having documented proof of poisoning and demanding compensation for moral and health impacts from the mining company [98]. This environmental disaster continues to shape community perceptions and concerns about ongoing mining activities, highlighting the long-term consequences of industrial accidents in remote locations with limited emergency response capacity.

Community consultations in Barskoon revealed a paradoxical situation where economic opportunities coexist with mounting health concerns. Residents acknowledged that Kumtor Gold Mine operations have resulted in higher employment rates compared to neighbouring settlements, elevating the social and financial status of the Barskoon community. These economic gains, however, fall short of community expectations and have come at a considerable cost to public health.

Local respondents reported alarming increases in morbidity and mortality rates across multiple health domains. Of particular concern is the rapid development of cardiovascular diseases among miners, with cases emerging after just one to two years of employment at the mine. Community members described a concerning pattern of lowered physiological body capacity among miners due to the demanding work shift schedule (15 days on, 15 days off with 12-hour shifts) at high altitude [90]. This work arrangement, combined with the physical demands of mining operations, appears to be contributing to accelerated health deterioration among workers. This finding aligns with recent research documenting cardiovascular diagnoses leading to unfitness for work among mining workers at 4,000 m above sea level in the Kyrgyz Republic over a 12-year period [98]. The community has also witnessed elevated incidence rates of dermatological conditions, allergies, mental distress, and oncological cases—health patterns that community members directly associated with mining operations.

The consultation findings also highlighted cases of occupational trauma and workplace fatalities, which respondents attributed to violations of labour rights and inadequate safety protocols. These incidents underscore the human cost of mining operations and raise questions about the adequacy of occupational health and safety standards applied to Canadian mining operations abroad. The absence of binding Canadian legislation requiring human rights and environmental due diligence means that workers at operations abroad are not guaranteed the same protections they would receive at local sites, and host countries with limited regulatory capacity may be unable or unwilling to fill this gap.

Perhaps most concerning is the reported damage to glacial systems in the region—damage that is permanent and cannot be remediated. Community members observed pollution and a reduction of glacial surface area, particularly affecting the Lysyi, Davydov's, and Petrov's glaciers. The proximity of large waste dumps to these glacial systems and to the source of the Syrdaria River raises serious questions about long-term water security and ecosystem integrity that will persist long after the mining ceases.

The consultation process revealed clear community priorities for addressing both immediate and legacy health impacts. Residents called for comprehensive medical examinations of the local population to establish baseline health data and monitor ongoing impacts from mining operations. They also prioritized the investigation of occupational mental health issues and optimization of shift work schedules to reduce physiological stress on workers' bodies. In terms of environmental health, community members expressed the need for a systematic investigation of dust particulate impacts on local flora and the broader ecosystem—knowledge vital to understanding post-mining environmental futures. Community members also emphasized the importance of addressing labour rights violations and investigating health inequities between families connected to Kumtor Gold Mine employment and those without such connections as these inequities will continue to inform community wellbeing long after the mine's departure.

Kumtor exemplifies how extractive industries, particularly those involving foreign corporate actors, can generate new health vulnerabilities by disrupting traditional livelihoods and introducing novel environmental stressors. Empirical research from developing regions consistently links proximity to mining sites with adverse health outcomes and diminished household welfare [89, 90, 99]. The case of Kumtor raises important ethical and policy considerations regarding the accountability of Canadian companies operating abroad for legacy impacts and whether current approaches to corporate responsibility adequately address the distinctive vulnerabilities of communities facing mine closure, vulnerabilities that persist long after extraction ceases [31].

Discussion

Community consultations in all three sites reflect the relevance of the interactions of commercial, political, and social determinants of health and the need for environmental justice, with health and environmental impacts embodied in a multitude of ways. Interwoven commercial and political determinants of health was evidenced by participant observations of state and regulatory capture, wherein governments keen to attract foreign investment may loosen or fail to enforce environmental and/

or occupational health standards. In two of our cases (the Philippines and Brazil) this extended to weakening or ignoring Indigenous rights (including rights to free, prior, and informed consent), enabling Canadian mines in these three sites to generally operate with impunity. Intimidation and harassment of local residents who raise objections to extractive activities, backed up by threats of physical violence in Brazil and the Philippines, led one Brazilian interlocutor, as previously noted, to remark that they were 'the walking dead.' With the spatial distancing from headquarters in Canada, the activities of local mining operations are offered plausible deniability for any of the structural or physical violence occurring in countries far removed from Canadian urban centres. Moreover, residents of local communities remained unconvinced of the sincerity of the responsible business conduct or corporate social responsibility practices that may be enumerated on annual reports but were invisible or unwanted and unused by local communities. Our findings demonstrate how corporate power, weak regulation, and structural inequities converge across mining life stages.

The centrality of these mines to the local economy further entrenches social and economic inequities and strengthens mines' ability to threaten residents with unemployment, underemployment, or closure. Those employed by the mines invariably pitted against those who may oppose them while divisions between unionized and non-unionized workers also exist. Miners are themselves conflicted by their economic status given the deleterious effects to their own health and that of their community and land. These intra-communal conflicts can disrupt social networks and erode access to social support; therefore, beyond employment dependency, mining reshapes social organization itself. In many of the Philippine study communities, subsistence farming and communal land-based practices are foundational, not only to livelihoods but also to social organization, cultural continuity, and health. As the Philippine example indicates, mining-related access restrictions and the displacement undermine traditional subsistence activities such as communal farming and cooperative exchange, reshaping livelihoods and weakening community cohesion. The Kyrgyz consultations drew attention to the incipient power dynamics amongst current Kumtor employees, former mine workers, and those without direct links to the mine that unsettle social cohesion. In Brazil, the dominance of the Kinross mine over community members in Paracatu contributed to a pervasive atmosphere of fear, distrust, and hopelessness as reflected in their self-description as the 'walking dead.'

International resource extraction—even in an exploratory phase—results in environmental and health burdens that are diffusely and inequitably distributed across

the community. Such patterns are consistent with documented cases of environmental injustice, in which Indigenous, marginalized, or remote populations disproportionately bear the costs of industrial activity. In all three sites, participants reported high rates of disease amongst current and former mine workers, often corroborated by empirical study. Notably, the poisoning of the environment, loss of ancestral lands, and disruption of traditional subsistence activities were presented as existential threats to cultural communities.

Environmental damage and its effects on social life impact communities as collections of bodies and the individual body that internalizes, interprets, and responds to these assaults. Across all mine life stages, these embodied processes manifest differently, yet the inscriptions of harm is constant and persists beyond the life of mine. The body is both archive and agent; the body remembers and the body acts. The accumulation of social, political, commercial, and environmental harms is inscribed on/in the body and expressed in the form of identifiable diseases and mental health conditions, and chronic stress. The individual and communal body mirror the land and mutually reflect the damage and dislocation attributed to the local mine. Memories, individual and collective, inform responses to current and anticipatory conditions. Prior experience with, and shared stories of, mining activities and their harms prefigure perceptions of risk and deleterious effects. Bodies, however, are able to perform resistance in the form of protest, ritual, and everyday refusal. Harm embodied and agency embodied are thus co-constituted reactions to the structural violence that attends to resource extractive activities [100–103].

Canada has international human rights obligations to take steps through regulation, administrative and other policy action to prevent private actors, such as mining corporations, from violating human rights, and to provide effective remedies where such violations occur. Yet, to date, Canada has done very little to ensure that Canadian mining companies operating transnationally take steps to prevent harmful conduct or to hold them accountable where harms have occurred. Unlike its peers in Europe, Canada has not enacted legislation to require Canadian mining companies to undertake ongoing actions through human rights and environmental due diligence (HREDD) to prevent harm from their overseas operations to individuals, communities and the environment or to provide effective remedies for victims of such harm. In April 2022, the federal government released a third version of its responsible business conduct strategy. This iteration encourages (rather than mandates) companies to comply with the United Nations Guiding Principles on Human Rights (UNGPs) and the OECD Guidelines for Multinational Enterprises on Responsible Business Conduct, including by undertaking HREDD

[104]. Just before the strategy was released a private members' bill was tabled in Parliament that, if it had been enacted, would have legally obliged Canadian companies to take such steps to avoid causing harm in their overseas operations and with liability on such companies for failing to comply with this obligation (Bill C-262) [105].

A range of cases have been brought in Canadian courts against Canadian extractive companies seeking damages for human rights and environmental harm. Foreign plaintiffs, however, face significant legal and practical obstacles in bringing such cases. Bill C-262 would have provided a remedy through Canadian courts for victims of such harm and would have addressed some of the legal obstacles to bringing such claims [105]. The bill never went beyond a first reading, and died with the prorogation of Parliament in early 2025. Canada did establish a quasi-judicial complaint mechanism in 2019, the Canadian Ombudsperson for Responsible Enterprise (CORE) with a mandate to receive and investigate allegations of wrongdoing by Canadian extractive and garment companies. However, contrary to promises by the federal government to endow the CORE with powers to compel witnesses and documents, the mechanism remains without such powers and therefore is unable to engage in credible investigations of complaints [106]. Additionally, the Ombudsperson position is currently vacant and the office itself is under review by the federal government. There is no guarantee that the office will continue, despite the fact that there are over 35 pending complaints [107].

Unless the host country effectively regulates Canadian mining companies for their human rights and environmental and health impacts, in the absence of Canada doing so, these businesses will operate with substantial impunity. Even in cases like Kumtor, where nationalization has transferred ownership to the host state, the underlying structural challenges persist. The announcement of a decades-long underground expansion [95] demonstrates that the community's exposure to environmental and occupational health risks is far from over, while the new operating context raises unanswered questions about transparency, labour rights, and the long-term stewardship of the region's fragile ecosystems under state management.

Despite the lethargy, obfuscation, and refusal of the Canadian government to take action on the global interests and actions of its corporations operating abroad, local efforts to resist the perceived and potential harms effected by Canadian extractive industries do exist, and are notable. Reflecting previous accounts of Indigenous movements in the Philippines [108, 109], community members highlighted the collective resistance that the Ibaloy, Kankanaey, Kalanguya, and Binongan communities organized against prior Canadian projects and the

successful resistance that people from Bokod and Kibungan launched against mining exploration using petitions, negotiations, and physical resistance. In Licuan-Baay (Abra), Binongan communities had declared Olympus Pacific Minerals (Besra Gold) persona non grata in 2008 when the company was found to have violated free, prior, and informed consent procedures. Such actions as these represent embodied resistance by Indigenous communities against health-harming commercial and political determinants. As participants emphasized, these defense movements were not just for land, water, or air but also for cultural integrity, cooperative ways of life, and *binnang* (mutual collective aid). One informant referred to these mobilizations as “the body’s protest”—an expression of collective health defense premised on identity and survival.

Similarly, residents of the Issyk-Kul Region in the Kyrgyz Republic have held protests, created road blockages, and engaged in advocacy in relation to glacier damage, tailings leakage, and unfair labour relations [110]. Kumor’s recent shift to underground mining under state control [95] serves as a potent reminder that the struggle for health, environmental justice, and corporate accountability does not end with a change in ownership; it evolves, demanding continued vigilance and community-centred research. In Brazil, years of grassroots mobilization spearheaded by the Volta Grande Alliance that included Indigenous and riverine communities led to the annulment of the federal court’s land-rights contract with the Canadian Belo Sun Mining Corporation [111]. This nullified plans for what was to become the largest open-pit gold mine in Brazil topographically located in the eco-sensitive Amazon Volta Grande do Xingu region [112]. The successful campaign combined strong Indigenous governance, credible evidence gathering, and issue-framing that resonated on both sides of the world.

Conclusion

We concur that “advances in public health occur when health researchers and practitioners, social movements, and political leaders committed to democracy and social justice join forces to capitalize on windows of opportunity opened by changing social, political, and economic circumstances” [35, p.92]. In addition, leveraging legal and governance structures to affirm and strengthen labour, health, and Indigenous rights is critical to social and environmental justice. In concert with these legal claims, we must acknowledge the role that communal resistance plays in opposing extraction as it affirms sovereignty, wellness, and intergenerational continuity—a shared embodiment of care against structural violence. People in Brazil, the Kyrgyz Republic, and the Philippines have demonstrated that resistance can serve as public health intervention by interrupting the extractive

wheels that produced disease, displacement, and disempowerment.

Canada must comply with its binding international human rights obligations and move beyond its failed policy approach to addressing the harmful impacts of transnational Canadian mining operations. At the very least it should enact legislation, like Bill C-262, that mandates companies to engage in human rights and environmental due diligence, requiring them to identify the potential and actual harmful human rights, environmental and health impacts of their projects and to engage in meaningful consultation with communities. Such a law should also require companies to take steps to prevent and mitigate such harm on an ongoing basis throughout the lifecycle of the project and to redress harm that does occur. It should also provide a cause of action in Canadian courts that addresses jurisdictional and other legal obstacles to bringing cases about harm that occurs in other countries.

Future research

Respondents in our community consultations were solidly in support of community-driven mining and health studies that would examine the psycho-social and cultural effects of transnational mines on the local populaces’ value systems, lifeways, and gendered social organization. They also called for work that would include temporal dimensions that pull in community life and environments pre-contact with mining and other resource industries to highlight the changes wrought by extractive activities and to collectively envision lifeways when the mining ceases to operate. Moreover, our interlocutors wish to document long-term occupational and environmental health impacts, particularly the respiratory and waterborne illnesses and explore food security and nutrition impacts from soil and water contamination. As corporate and governmental environmental impact and health outcome data, where conducted, are often proprietary or unavailable, future research must prioritize partnerships that facilitate appropriately rigorous community-driven and participatory studies and data transparency. Furthermore, stories of successful resistance including claims for compensation and justice need also be shared. Critically, future research must be conducted with and be accountable to local communities.

Abbreviations

CDH	Commercial Determinants of Health
JCAP	Justice and Corporate Accountability Project
PDH	Political Determinants of Health
PTSD	Post-traumatic stress disorder
SDH	Social Determinants of Health
WHO	World Health Organization

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Author contributions

All authors contributed to: the development of our research proposal, data analysis, and the writing and review of this manuscript. DLS conceived of and helped design the study, taking a leading role in the grant application, drafted the outline for this paper, and articulated our theoretical lenses. ECP led the Philippine portion of the study, assisting with proposal development, and conducting community consultations. PS provided the transnational legal context for the study, contributing to the conceptualization and writing of the proposal and this paper. KD and FW contributed to the proposal, local study design, and this paper, having led community consultations in Kyrgyz Republic and Brazil respectively. JG and JB offered their expertise in environmental health in the proposal and this manuscript. RL contributed expertise on global governance issues, and, along with JG, provided editorial oversight.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study received research ethics approval from the University of Alberta (PRO00132998). All interlocutors signed or recorded their agreement to participate after reviewing the content of the consent form with members of the research team in their local common language. The consent form outlined the voluntary nature of their participation, our commitment to maintaining confidentiality and anonymity—and the limits to this in the case of focus group discussions—and their rights to withdraw.

Note

Corporate social responsibility (CSR) and business human rights (BHR), although often conflated, have different histories and foci. CSR focuses on voluntary actions by business to address concerns about their social responsibility. BHR, on the other hand, is grounded in international human rights law and focuses on corporate accountability (see A. Ramastry, “Corporate social responsibility versus business and human rights: Bridging the gap between responsibility and accountability”, *Journal of Human Rights* 14, 2 (2015): 237–259. Responsible business conduct (RBC) is a term used by the OECD Guidelines for Multinational Enterprises on Responsible Conduct (2023). These guidelines are one of the key sets of BHR norms. The OECD Guidelines cover areas beyond human rights due diligence from the United Nations Guiding Principles on Business and Human Rights, which requires multinational companies to undertake early and ongoing due diligence to prevent and redress harmful conduct associated with their business activities.

Competing interests

The authors declare no competing interests.

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References

1. NRC. Minerals and the Economy - Natural Resources Canada. 2023. <https://natural-resources.canada.ca/minerals-mining/mining-data-statistics-analysis/minerals-economy>.
2. NRC. Canadian Mining Assets (January). 2025. <https://natural-resources.canada.ca/minerals-mining/mining-data-statistics-analysis/minerals-mining-publications/canadian-mining-assets>.
3. Cordillera People's Alliance. Case Study on the Impacts of Mining and Dams on the Environment and Indigenous Peoples in Benguet, Cordillera, Philippines. United Nations Department of Economic and Social Affairs, international expert group meeting on Indigenous Peoples and protection of the environment. Russian Federation: Khabarovsk; 2007.
4. Dzhusupov KO, Colosio C, Tabibi R, Sulaimanova CT. Occupational health in mountainous Kyrgyzstan. *Annal Glob Health*. 81(4):530–537. <https://doi.org/10.1016/j.aogh.2015.08.017> regions: The coal mining region of Santa Catarina, Brazil. *Nat Resour Forum*. 2015;29. <https://doi.org/10.1111/j.1477-8947.2005.0108.x>.
5. Glauser S, McAllister ML, Milioli G. The challenges of sustainability in mining regions: The coal mining region of Santa Catarina, Brazil. *Nat Resour Forum*. 2005;29. <https://doi.org/10.1111/j.1477-8947.2005.00108.x>.
6. Holden W, Jacobson R. Mining amid decentralization: local governments and mining in the Philippines. *Nat Res For*. 2006;30:188–98.
7. Torgoev IA, Omorov B. Mass movement in the waste dump of high-altitude Kumtor gold mine (Kyrgyzstan). In: *Proceedings of the 3rd World Landslide Forum*; 2014; Beijing, China.
8. Beckett C, Keeling A. Rethinking remediation: mine reclamation, environmental justice, and relations of care. *Int J Justice Sustain*. 2019;24(3):216–30.
9. Hall R, Ascough H. Care through closure: mine transitions in the mixed economy of the Northwest Territories, Canada. *Gender Place Culture*. 2023;30(10):1415–36.
10. Monosky M, Keeling A. Planning for social and community-engaged closure: A comparison of mine closure plans from Canada's territorial and provincial North. *J Environ Manage*. 2021;227(11324):1–10.
11. Anvil Mining See Assoc. canadienne contre l'impunité (A.C.C.L) c. Anvil Mining Ltd., 2011 QCCS 1966 (C.S. Que.), reversed [2012] J.Q. no. 368, 2012 QCCA 117 (C.A. Que.), leave to appeal refused 2012 CarswellQue 11091 (S.C.C.).
12. Araya v. Nevsun Resources Ltd. 2016 BCSC 1856; Araya v. Nevsun Resources Ltd., 2017 BCCA; Nevsun Resources Ltd. v. Araya, 2020 SCC.
13. Presbyterian Church of Sudan v. Talisman Energy, 582 F.3d 244 (2nd Cir, 2009).
14. Human Rights Watch. Papua New Guinea - Gold's Costly Dividend: Human Rights Impacts of Papua New Guinea's Porgera Gold Mine; 2011. <https://www.hrw.org/report/2011/02/01/golds-costly-dividend/human-rights-impacts-papua-new-guineas-porgera-gold-mine>.
15. Hubday Minerals Inc. 2013 ONSC 1414 (Ont. S.C.J.).
16. JCAP. The Canada Brand: Violence and Canadian Mining Companies in Latin America; 2017. <https://justice-project.org/the-canada-brand-violence-and-canadian-mining-companies-in-latin-america/>.
17. JCAP. The Two Faces of Canadian Diplomacy: Undermining Human Rights and Environment Defenders to Support Canadian Mining; 2022. https://justice-project.org/wp-content/uploads/2022/12/2022-12-09_JCAP_TheTwoFacesofCanadianDiplomacy_Reduced-2.pdf.
18. Simons P. Developments in Canada on business and human rights: one step forward, two steps back. 36:1 *Leiden J Int Law*. 2023;36(1):363–368.
19. Above Ground and Justiça Global. Swept Aside: An Investigation into Human Rights Abuse at Kinross Gold's Morro de Ouro Mine; 2017. <https://aboveground.ngo/wp-content/uploads/2017/Swept-Aside-Kinross-Morro-do-Ouro-report.pdf>.

20. Khare SN. Community resistance to Canadian transnational mining operations in Latin America. [master's thesis]. Saskatoon (CA): University of Saskatchewan; 2018.
21. Cohen M. Doing business abroad: A review of selected case-studies on corporate accountability for foreign human rights violations. *Int J Hum Rights*. 2020;24(10):1499–514. <https://doi.org/10.1080/13642987.2020.1729134>.
22. Simons P, Macklin A. The governance gap: extractive industries, human rights and the home state advantage. New York: Routledge; 2014.
23. UN Office of the High Commissioner for Human Rights. United Nations guiding principles on business and human rights: implementing the United Nations 'protect, respect and remedy' framework. 2011. Retrieved from https://www.ohchr.org/documents/publications/guidingprinciplesbusinesshr_en.pdf.
24. Simons P. International law's invisible hand and the future of corporate accountability for violations of human rights. *J Hum Rights Environ*. 2012;3(1).
25. Amengual M. Buying stability: The distributive outcomes of private politics in the Bolivian mining industry. *World Dev*. 2018;104:31–45.
26. Henisz W, Dorobantu S, Nartey LJ. Spinning Gold: The Financial Returns to Stakeholder Engagement. *Strateg Manag J*. 2014;35:1727–48.
27. Prno J. An analysis of factors leading to the establishment of a social licence to operate in the mining industry. *Resour Policy*. 2013;38:577–90.
28. Conde M, Le Billon P. Why do some communities resist mining projects while others do not? *Extractive Industries Soc*. 2017;4(3):681–97.
29. Boutillier RG, Thomson I. Modelling and measuring the social licence to operate: fruits of a dialogue between theory and practice. 2011. Available from: <https://sociallicense.com/publications/Modelling%20and%20Measuring%20the%20SLO.pdf>.
30. Bice S, Brueckner M, Pforr C. Putting social license to operate on the map. A social actuarial and political risk and licensing model (SAP Model). *Resour Policy*. 2017;53:46–55.
31. Moffat K, Lacey J, Zhang A. The social licence to operate: a critical review. *Forestry: Int J For Res*. 2016;89(5):477–88.
32. Birn AE, Shipton L, Schrecker T. Canadian mining and ill health in Latin America: A call to action. *Can J Public Health*. 2018;109:786–90. <https://doi.org/10.17269/s41997-018-0113-y>.
33. Wood B, Lacy-Nichols J, Sacks G. Taking on the corporate determinants of ill-health and health inequity: a scoping review of actions to address excessive corporate power to protect and promote the public's health. *Intl J Hlth Pol Mgt*. 2023;12:7304–21.
34. Fox N. Capitalism and the commercial determinants of health: a more-than-human micropolitics. *Soc Sci Med*. 2024;350:116295.
35. Freudenberg N. Framing commercial determinants of health: an assessment of potential for guiding more effective responses to the public health crises of the 21st century. *Mill Quart*. 2023;101(S1):83–98.
36. Freudenberg N. Integrating social, political, and commercial determinants of health frameworks to advance public health in the twenty-first century. *Intl J SDH Serv*. 2023;53(1):4–10.
37. Persaud A, Bhugra D, Valsraj K, Bhavsar V. Understanding geopolitical determinants of health. *Bull WHO*. 2021;99:166–8.
38. Muntaner C, Benach J. Why social, political, economic, cultural, ecological determinants of health? part 1: background of a contested construct. *Intl J SDH Hlth Ser*. 2023;53(2):117–21.
39. Jones C. Systems of power, axes of inequity: parallels, intersections, braiding the strands. *Med Care*. 2014;10(S3):S71–5.
40. Chowkwanyun M. Environmental justice: where it has been, and where it might be going. *Annu Rev Public Health*. 2023 Apr 3;44:93–111.
41. Hendryx M, Zullig KJ, Luo J. Impacts of Coal Use on Health. *Annu Rev Public Health*. 2020;41:397–415. <https://doi.org/10.1146/annurev-publhealth-040119-094104>. Epub 2020 Jan 8. PMID: 31913772.
42. Greenberg PC, Waste S, Change. Environmental Inequality in Appalachia: Implications for a Just Transition in Coal Country. *Soc Nat Resour*. 2018;31:995–1011. <https://doi.org/10.1080/08941920.2018.1456593>.
43. Castro MC, Krieger GR, Balge MZ, Tanner M, Utzinger J, Whittaker M, Singer BH. Examples of coupled human and environmental systems from the extractive industry and hydropower sector interfaces. *Proc Natl Acad Sci U S A*. 2016;113:14528–35. <https://doi.org/10.1073/pnas.1605678113>.
44. Burger J, Gochfeld M, Kosson DS, Brown KG, Salisbury J, Greenberg M, Jeitner C. Combining ecological, eco-cultural, and environmental justice parameters to create Eco-EJ indicators to monitor cultural and environmental justices for diverse communities around contaminated sites. *Environ Monit Assess*. 2022;194:177. <https://doi.org/10.1007/s10661-021-09535-8>. PMID: 35150318; PMCID: PMC9488455.
45. Scheidel A, Fernández-Llamazares Á, Bara AH, Del Bene D, David-Chavez DM, Fanari E, Garba I, Hanaček K, Liu J, Martínez-Alier J, Navas G, Reyes-García V, Roy B, Temper L, Thiri MA, Tran D, Walter M, Whyte KP. Global impacts of extractive and industrial development projects on Indigenous Peoples' lifeways, lands, and rights. *Sci Adv*. 2023;9:eade9557. <https://doi.org/10.1126/sciadv.ade9557>. Epub 2023 Jun 7. PMID: 37285420; PMCID: PMC10246906.
46. Spitzer DL. Engendered movements: migration, gender, and health in a globalized world. In: Gideon J, editor. *Handbook of Gender and Health*. London: Elgar; 2016. pp. 251–67.
47. Spitzer DL. Intersectional and embodied: migration as a social determinant of health. In: Bryant T, editor. *Handbook on the Social Determinants of Health*. London: Elgar; 2025. pp. 204–19.
48. Spitzer DL. Work, worries and weariness: towards an embodied and engendered migrant health. In: Spitzer DL, editor. *Engendering Migrant Health: Canadian Perspectives*. Toronto (CA): University of Toronto Press; 2011. p. 23–39.
49. Dunn K. Embodied transnationalism: bodies in transnational space. *Pop Spce Plce*. 2010;16:1–9.
50. Hesse-Biber S, Johnson RB. Coming at things differently: future directions of possible engagement with mixed methods research. *Jour Mix Meth Res*. 2013;7(2):103–9.
51. Priya A. Case study methodology of qualitative research: key attributes and navigating the conundrum of its application. *Soc Bul*. 2020;1–17. <https://doi.org/10.1177/0038022920970318>.
52. Snooks G, Nagy R, Timms R, Debassige D, Jodouin K, Quenneville B, Chen L. Blending feminist, Indigenous, and participatory action research methodologies: critical reflections from the Northeastern Ontario Research Alliance on Human Trafficking. *Fem Form*. 2021;33(2):160–84.
53. Aytin A. A social movements' perspective on human rights impact of mining liberalization in the Philippines. *New Sol: Jour Envir Occu Hlth Pol*. 2016;25(4):538–58.
54. Chavez L. Fast facts: mining in the Philippines. *Rappler* 2017. Available from: <https://www.rappler.com/business/special-report/whymining/whymining-late-stories/11983-fast-facts-mining-philippines>.
55. Zoledziowski A, Gutierrez J. Canadian mining in the Philippines: The battle for ancestral lands. *VICE News Investigations*; 2020.
56. Mines and Geosciences Bureau (MGB). Inventory of approved mining tenements. Department of Environment and Natural Resources (DENR); 2018.
57. Cordillera Peoples Alliance (CPA). Abra river: a river poisoned. Environmental Justice Series No. 2. Baguio City (PH): CPA; 2015.
58. Cordillera Peoples Alliance (CPA). Corporate plunder and community resistance: the struggle of the Igorot people. CPA; 2008.
59. Mertins-Kirkwood H, Smith B. Digging for dividends: the use and abuse of investor-state dispute settlement by Canadian investors abroad. *Canadian Centre for Policy Alternatives*; 2019.
60. Holden W. Civil society opposition to nonferrous metals mining in the Philippines. *Voluntas: Inter Jour Vol NPO*. 2005;16(3):223–49.
61. Olea R, Barry J. The performance of free, prior and informed consent (FPIC) in the Philippines: Reflections from an Indigenous rights-based case study. *Res Pol*. 2021;70:101938. <https://doi.org/10.1016/j.resourpol.2020.101938>.
62. Holden W, Nadeau K, Jacobson R. Civil society opposition to nonferrous metals mining in the Philippines: A review of opposition to the Tampakan copper-gold and Didipio gold-copper projects. *Extr Ind Soc*. 2019;6(3):707–17. Tebteba Foundation 3.
63. Tebteba Foundation. Indigenous Peoples and Extractive Industries in the Philippines: Trends, Impacts and Responses. Baguio City: Tebteba Foundation; 2021. Available at: <https://www.tebteba.org/index.php/resources-menu/publications-menu/reports>.
64. Cordillera Peoples Alliance (CPA). Mining updates and ancestral land claims report. Internal report; 2023.
65. Veridiano J, Holden W. Free, prior and informed consent in the Philippines: Indigenous rights and resource extraction. *Cordillera Ext Ind Soc*. 2022;9(1):101000. <https://doi.org/10.1016/j.exis.2021.101000>.
66. Sinumlag AB. NCIP denies Kibungan Mine's counterclaim. *Northern Dispatch [Internet]*. 2011 Mar 6 [cited 2026 Mar 16]. <https://www.nordis.net>.
67. Salvador-Amores A, Dulnuan J, Taguiba B. Gendered geographies of resistance: Indigenous women's leadership in anti-mining struggles in the Cordillera. *North Philippines Asian J Wom Stud*. 2020;26(3):386–406. <https://doi.org/10.1080/12259276.2020.1807470>.
68. Buss D, Rutherford B. Gendering corporate social responsibility: Women contesting mining in the Philippines. *Th Wrlld Quart*. 2020;41(5):786–803. <https://doi.org/10.1080/01436597.2019.1697726>.

69. Kinross Gold Corporation [Internet]. Kinross Completes Purchase of 51% of Paracatu Mine, Brazil. Toronto: Kinross Gold Corporation. 2004 Dec 31 [cited 2024 Feb 25] Available from: <https://www.kinross.com/news-and-investors/news-releases/press-release-details/2004/Kinross-Completes-Purchase-of-51-of-Paracatu-Mine-Brazil/default.aspx>.
70. Kinross Gold. Kinross Gold Brazil; 2020. <http://kinross.com.br/>. Accessed 14 Feb 2022.
71. Türke MAV. Business and Human Rights in Brazil: exploring human rights due diligence and operational-level grievance mechanisms in the case of Kinross Paracatu gold mine. *Rev Dir Int.* 2018;15(2):221–41. [cited 2024 Oct 31]. <https://www.publicacoesacademicas.uniceub.br/rdi/article/view/5357>.
72. Ministério da Ciência, Tecnologia e Inovações, Centro de Tecnologia Mineral (CETEM). Gold mining in Paracatu (MG) affects traditional communities and the environment. 2012 Jan 8 [cited 2023 Nov 20]. <http://verbetes.cetem.gov.br/verbetes/ExibeVerbetes.aspx?verid=201>.
73. Viglio EP, Invernizzi AP, Baptista DR, Silveira MCM. National soil background obtained in low-density geochemical surveys executed by the geological survey of Brazil – 2003–2017. *Informe Técnico-Científico de Prevenção de Desastres e Ordenamento Territorial.* 2022;3(2). [cited 2024 Jan 23] <https://rig.eo.sgb.gov.br/items/92f15f12-2156-45a6-a3d4-f55319a65d74/full>.
74. Brazilian Institute of Geography. Paracatu: População. 2021. <https://cidades.ibge.gov.br/brasil/mg/paracatu/panorama>. Accessed 25 February 2022.
75. Above, Ground. Justiça Global [Internet]. Swept aside: a community's fight for a safe environment near a Kinross gold mine in Brazil. Ottawa (ON): Above Ground; 2017 Dec [cited 2023 Apr 10]. 44 p. Available from: <https://aboveground.ngo/wp-content/uploads/2017/12/Swept-Aside-Kinross-Morro-do-Our-o-report.pdf>.
76. Firmiano FD. The destructive logic of mining in Paracatu-MG. *Revista.* 2020 [cited 2022 Feb 14]. <https://revista.fct.unesp.br/index.php/nera/article/view/6847> Accessed 14 February 2022.
77. Kazantseva M. Mining companies and sustainability: role of CSR in Canadian mining companies in Brazil. FGV Digital Repository; 2019 [cited 2022 Feb 14]. <https://bibliotecadigital.fgv.br/dspace/handle/10438/28738>. Accessed Feb 14 2022.
78. Dani SU, Malavolta CRG, José dos Santos M, Serrano-Neves PM, Terrier L. Geocide, ecocide, and genocidal type outcomes from large-scale open pit mountaintop gold mining in the outskirts of Paracatu, Brazil. *Environ Justice.* 2019;12(3). <https://doi.org/10.1089/env.2018.0039>.
79. Angelo M. Brazil's largest dam – 60 times the size of the Brumadinho dam – is under investigation. Mining Observatory [Internet]. 2020 Mar 12 [cited 2023 Oct 16]. Available from: <https://observatoriadamineracao.com.br/maior-barragem-do-brasil-60-vezes-a-de-brumadinho-e-alvo-de-investigacao-exploracao-de-ouro-da-kinross-em-mg-deve-acabar-em-2030/>.
80. Kumtor. Contribution to the Economy. n.d. Retrieved from: <https://www.kumtor.kg/en/contribution-to-the-kyrgyz-economy/> Accessed 1 June 2020.
81. Wooden AE. Kyrgyzstan's dark ages: framing and the 2010 hydroelectric revolution. *Cent Asia Sur.* 2014;33(4):463–81. <https://doi.org/10.1080/02634937.2014.989755>.
82. Torgoev IA. Glaciers, gold and geoecology of Kumtor mine. [in Russian]. Bishkek (KG); 2016. 197 p. [cited 2025 Jul 31]. Available at: <https://www.researchgate.net/publication/323809030>. Accessed 31/07/2025.
83. Goldberg PN. Medical and social problems of shift work in the highlands. *Fundamental and Applied Aspects of Mining Medicine.* Kyrgyzstan: Bishkek; 1992.
84. Vinnikov D, Brimkulov N, Krasotski V, Redding-Jones R, Blanc PD. Risk factors for occupational acute mountain sickness. *Occup Med.* 2014;64:483–9. <https://doi.org/10.1093/ocNMed/kqu094>.
85. Khamitova VZ. The role of the physicochemical properties of mine dust in the pathogenesis of pneumoconiosis. In: *Proceedings of the Second Symposium on the Pathogenesis of Pneumoconiosis*; 1978; Kapaganda.
86. Khukhrina EV, Tkachev VV. *Pneumoconiosis and their prevention.* Moscow; 1988.
87. Rodahl K. Occupational Health Conditions in Extreme Environments. *Ann Occup Hyg.* 2003;43(3):241–52.
88. Pikulicka-Wilczewska A. Kyrgyzstan moves to nationalise gold mine run by Canadian company. *Al Jazeera*; 2021 Jul 9 [cited 2022 Feb 25]. Available at: <https://www.aljazeera.com/news/2021/7/9/kyrgyzstan-moves-to-nationalise-gold-mine-run-by-canadian-company>. Accessed 25 February 2022.
89. Vinnikov D, Saktapov A, Romanova Z, Ualiyeva A, Krasotski V. Work at high altitude and non-fatal cardiovascular disease associated with unfitnes to work: Prospective cohort observation. *PLoS ONE.* 2024;19(7):e0306046. <https://doi.org/10.1371/journal.pone.0306046>.
90. Vinnikov D, Krasotski V. Healthy worker survival effect at a high-altitude mine: prospective cohort observation. *Sci Rep.* 2022;12:13903. <https://doi.org/10.1038/s41598-022-18331-4>.
91. Norlen D, Center for International Environmental Law. The Kumtor gold mine: spewing toxics from on high. Washington, DC: Pacific Environment and Resources Center; 2000 Sep [cited 2025 Jul 31]. Available from: <https://www.ciel.org/Publications/IFCCSKyrgyzstan.pdf>.
92. Wooden AE, Stefes CH. *The politics of transition in Central Asia and the Caucasus: enduring legacies and emerging challenges.* 1st ed. London: Routledge; 2009. <https://doi.org/10.4324/9780203027905>.
93. Kumtor. Top Management. 2021 <https://www.kumtor.kg/en/about/top-management/>. Accessed 25 February 2022.
94. Putz C. Kyrgyzstan and Centerra in talks for out-of-court dispute resolution over Kumtor. *The Diplomat.* 2022 Jan 07. <https://thediplomat.com/2022/01/kyrgyzstan-and-centerra-in-talks-for-out-of-court-dispute-resolution-over-kumtor/>. Accessed 25 February 2022.
95. Putz C. Underground mining starts at Kyrgyzstan's infamous Kumtor Gold Mine. *The Diplomat.* ; 2025 Aug 29 [cited 2026 Feb 20]. Available from: <https://thediplomat.com/2025/08/underground-mining-starts-at-kyrgyzstans-infamous-kumtor-gold-mine/>.
96. Torgoev IA. *Glaciers, Gold and Geoecology of Kumtor Mine.* [in Russian]. Bishkek (KG); 2016. 197 p. [cited 2025 Jul 31]. Available from: <https://www.researchgate.net/publication/323809030>.
97. WHO-ECEH (European Centre of Environment and Health). Accident in Barskoon (Kyrgyzstan). Case Studies CHEST Project. Bilthoven, Netherlands: National Institute of Public Health and the Environment (RIVM); 2003 [cited 2025 Jul 31]. https://ec.europa.eu/health/ph_projects/2003/action3/docs/2003_3_09_cs4_en.pdf. Accessed 31.07.2025.
98. Fumagalli M. The Kumtor gold mine and the rise of resource nationalism in Kyrgyzstan. *Central Asia Economic Paper Series.* no. 16, Aug.21. George Washington University, Central Asia Program, Washington, DC; 2015. <https://centralasiaprogram.org/publications-all/the-kumtor-gold-mine-and-the-rise-of-resource-nationalism-in-kyrgyzstan/>.
99. von der Goltz J, Barnwal P. Mines: the local wealth and health effects of mineral mining in developing countries. *J Dev Econ.* 2018;139(C):1–16. <https://doi.org/10.1016/j.jdeveco.2018.05.005>.
100. Quiroz D, Quiceno Mesa MP, Ospina Salinas E. Occupational Safety and Health Risks. The situation of direct and outsourced mining workers in Bolivia, Colombia, and Peru, Amsterdam, The Netherlands: Profundo; 2023 Jan. https://www.cvninternacional.nl/_Resources/Persistent/3/ff/d/6/3fd6a31c02b6d87870d4eca39bb872ec689caf5f/CNVI-0374%20Profundo%20OSH%20risks%20of%20mining%20workers%20in%20Bolivia%20Colombia%20and%20Peru%20Report.pdf.
101. Elgstrand EK, Vingard E. Occupational Safety and Health in Mining. *Anthology on the situation in 16 mining countries.* University of Gothenburg. *Arbete och Halsa NR.* 2013;47(2):186. https://gupea.ub.gu.se/bitstream/handle/2077/32882/gupea_2077_32882_1.pdf.
102. Lee RS, Collins K, Perez-Brumer A. COVID-19, violence and the structural determinants of death: Canada's Seasonal Agricultural Worker Programme. *Glob Pub Hlth.* 2022;17(5):784–93.
103. Simpson LB. Land as pedagogy: Nishnaabeg intelligence and rebellious transformation. *Decolonization: Indigeneity Educ Soc.* 2021;10(1).
104. Canada. Responsible Business Conduct Abroad: Canada's Strategy for the Future; 2021. <https://www.international.gc.ca/trade-commerce/assets/pdfs/rbc-cre/strategy-2021-strategie-1-eng.pdf>.
105. Bill C-262. An Act Respecting the Corporate Responsibility to Prevent, Address and Remedy Adverse Impacts on Human Rights Occurring in Relation to Business Activities Conducted Abroad, 44th Parl., 1st Sess., 2021 (first reading completed 29 March 2022).
106. Order in Council. (2019). PC No. 2019–1323, 6 September 2019. <https://order-in-council.canada.ca/attachment.php?attach=37587=en>.
107. Canadian Network on Corporate Accountability. Government Policy; 2020. Retrieved from: <http://cnca-rcrce.ca/resources/due-diligence-csr-mining>.
108. Ramo A. *Indigenous land rights and mining in the Cordillera: the struggle continues.* Tebtebba Foundation; 2007.
109. Bengwayan MA. The threat of mining still haunts the Cordilleras. *Philippine Daily Inquirer*; 2022 Apr 11. <https://opinion.inquirer.net/151633/the-threat-of-mining-still-haunts-the-cordilleras>.
110. Satke R. Conflict continues at Kyrgyzstan's massive gold mine. *Al Jazeera*; 2016 Feb 19 <https://www.aljazeera.com/features/2016/2/19/conflict-continues-at-kyrgyzstans-massive-gold-mine>.

111. Amazon Watch. Brazilian Justice Voided Belo Sun Mining's Concession. Press Release. 2024 December 3. <https://amazonwatch.org/news/2024/1203-brazilian-justice-voids-belo-sun-minings-concession>.
112. Vargas AP, Alfinito AC. Major victory to halt mining in the heart of the Brazilian Amazon. Amazon Watch; 2024 Dec 5. <https://amazonwatch.org/news/2024/1205-major-victory-to-halt-mining-in-the-heart-of-the-brazilian-amazon>.

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