Advanced Review

Alloyed waterscapes: mining and water at the nexus of corporate social responsibility, resource nationalism, and small-scale mining

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This article reviews the relationship between mining and water governance with an emphasis on Latin America. Focusing on the last decade, it identifies three major shifts in global mineral relations: (1) changes to corporation–community relations, most noticeable in corporate social responsibility projects; (2) changes to state–society relations, where there has been a simultaneous strengthening of international support for community rights and a reassertion of the nation-state through so-called 'resource nationalism'; and (3) challenges to the notion of 'community,' which must now stretch to encompass small-scale and artisanal miners. While examining each of these thematic shifts, the paper draws out the relationship between mining and water, suggesting that attention to the 'alloyed waterscape' of global mining would provide a compelling conceptual lens through which to explore dynamics that transcend scales and institutional divides.

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INTRODUCTION

While the inseparability of mineral extraction and water resources has long been recognized, this nexus is experiencing something of a renaissance in contemporary academic literature.[1–3] On the heel of two decades' worth of economic liberalization, which fuelled a transnational rush to acquire rights to new mineral deposits,[4] a boom in mineral prices in the first decade of the 21st century spurred the intensification and proliferation of extractive activities around the world.[5,6] The environmental effects of extraction, particularly its impact on water used by surrounding communities for drinking, livestock, and irrigation, sparked widespread antimining mobilization and enabled a close articulation of environmental activism and 'local community,' which was frequently linked to indigenous territorial struggles.[7–9]

While both the environmental impacts of the neoliberal reforms and the constitutive role of nature in neoliberalizing processes have been well documented,[10–13] this review attends to a more recent conjuncture. In this paper, I identify major shifts that have taken place in the global mining sector over the last decade and explore the ways that water has been constitutive of these processes. Specifically, I focus on three interrelated themes that, I argue, are transforming global mineral relations: (1) changes to corporation–community relations, most notably in the form of corporate social responsibility (CSR); (2) changes to state–society relations, where there has been a simultaneous strengthening of international support for community rights and a reassertion of the nation-state through so-called 'resource nationalism'; and (3) new challenges to the

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notion of 'community,' which must now stretch to encompass small-scale and artisanal miners.

These three themes are loosely associated with scales of governance (transnational, national, local), but the materiality of water challenges these traditional scales,[14–16] a fact that is especially true with regard to mining.[17] Mining has enormous impacts on the quality, quantity, and flow patterns of water, but as it flows, seeps, and drains, water also remakes mining landscapes physically and politically.[18,19] The movement of water thus reconfigures each scale, rendering necessary a *conjunctural* exploration that considers changes at multiple scales of the mining sector simultaneously. Focusing on Latin America, where my own research is based, I use the term *alloyed waterscape* to highlight the grounded interrelations of water and mining across multiple scales of governance.

Following a discussion of the term alloyed waterscape that highlights key mechanical interconnections and political flashpoints between water and mining, I present each of the three conjunctural themes identified above and explore their connections to water. I conclude by reflecting on directions for future research given the contemporary mining–water conjuncture.

ALLOYED WATERSCAPES

Water is required by mining operations to minimize dust, maintain functional equipment, and separate valuable mineral from worthless rock through gravitational or chemical processes.[1] It is also necessary for the maintenance of all human and nonhuman life. As such, water is often a lightning rod in mining conflicts, and struggles over the quality, quantity, and availability of water shape the legal and infrastructural futures of mining.

But water is more than just a source of friction in the political economic landscape of mining. The notion of 'waterscape' has been used by scholars to explore the socionatural dimensions of water or the processes through which water and society continuously remake one another.[20] This concept moves away from a focus on either political scales of water governance (neighborhood, city, province, nation-state) or natural scales of water governance (river, wetland, watershed) to consider multiscalar interactions across the human–nature divide. Mining in particular 'configures water flows and issues in ways that transcend conventional spatial containers and administrative structures' (Ref 17, p. 21). I use the term alloyed waterscape to convey the multiscalar reforging of mining governance that takes place through the movement of and struggles over global water resources. To unpack this term, it is worth summarizing the physical impacts of mining on water in detail.

The most frequently observed effects of mining are widespread surface and subsoil water contamination (quality effect), reduced river flow and lowered water tables (quantity effect), and altered patterns of water flow (availability effect).[21] Of these, contamination is the most commonly cited concern. Contamination occurs through both synthetic and 'natural' processes. Chemicals such as mercury and cyanide are often added during processing procedures to separate valuable minerals from waste rock, but as rock is brought to the surface and crushed, its increased exposure to air and water also catalyzes or hastens naturally occurring chemical reactions. This process generates acid and metalliferous draining (AMD), which can continue for decades after the mineral has been extracted, even long after mine closure.[3,21]

Although most modern mines have dams and tailings ponds to minimize the impacts of chemical leaching, these measures are not guarantees against contamination. Dam breaches can result in massive environmental disasters, as occurred in 2014 at the Mount Polley copper and gold mine in Canada, when 25 million cubic meters of mine tailing and effluent were released into surrounding lakes and rivers.[22] This breach had a serious impact on regional First Nations, for whom salmon drawn from the Fraser River watershed is nutritionally and culturally important.[23] In less-regulated contexts, such as the state-owned Huanuni mine in Bolivia, untreated waste water is dumped directly into nearby rivers, where it not only spreads heavy metals, such as arsenic, lead, cadmium, iron, and zinc, but also carries with it toxic sediment loads that alter river courses and fill formally fertile floodplains. These toxins can make their way into residents' bodies through drinking water and food cultivation.[24]

Because much of the mineral extraction takes place below the water table, water must be continuously pumped out of the mine (a process known as 'dewatering'), which alters natural storage, recharge, and discharge of groundwater,[3] sometimes to such an extent that entire upstream lakes disappear.[25] People living near mines therefore often complain of difficulties accessing groundwater for drinking or irrigation. The large spatial footprint of mining is only exacerbated by the fact that many new mines are being built in the headwaters of important rivers; the area that is affected by the mine is thus significantly larger than the mining concession itself.[21] For example, Bebbington and Bury have shown that 58% of mining concessions in Peru are located at

≥3000 meters above sea level, and the watersheds supplying the capital city of Lima are at least 30% under concession.[25] Local water rights, moreover, are often granted preferentially to mining operations over small-scale drinking or irrigation demands.[26,27] In response, local livelihoods must shift to include practices such as wage labor, land sales (particularly appealing when mining has raised the value of land), and livestock intensification.[25,28,29]

But this is not a unidirectional causal chain. Just as mining has an impact on water resources, the quantity, quality, and availability of water also affect where mines are established, the infrastructure that develops around them, and the limits of extractive technology.[2] Water's flows impose material constraints, making it difficult to control political boundaries, grant ownership or use rights, construct or maintain infrastructure, and contain contamination. Political mobilizations to protect water, moreover, can contribute to the rewriting of legal constraints.

A particularly famous example of the interconnections between mining, water, and politics is the case of the Pascua-Lama gold mine on the Chilean–Argentine border. Slated to be the second largest gold mine in South America, in the early 2000s, Pascua-Lama became a site of significant conflict when concerns were raised about the impact that Canadian corporation Barrick Gold would have on local water resources. The mine was to be built in the headwaters of the watershed that supplied water to small-scale farmers across the Huasco Valley, which stretches from the Andes to the Pacific Ocean.[30] Moreover, local farmers relied on runoff from nearby glaciers to regulate water flows in the arid Atacama region. In the Environmental Impact Assessment (EIA) that Barrick Gold submitted to the Chilean and Argentine governments in 2000, it presented plans to relocate three glaciers in order to access minerals underneath,[31] but Barrick Gold used data that failed to account for either seasonal water variability, to which local farmers were acutely attuned,[30] or the meanings attached to these glaciers by both local farmers and climate change activists, for whom glacier retreat carries profound weight. Indeed, the resistance movement that developed around Pascua-Lama was able to 'jump scales,' or move the local battle into the national and international arenas, partly due to this shared concern for glaciers.[32] Mounting pressure from activists, NGOs, and academics pushed Barrick Gold to modify its proposed plan in a way that avoided moving or disturbing regional glaciers.[30] The Chilean and Argentine governments approved the updated EIA provided that the corporation developed a comprehensive water management plan. The regional water dispute, however, remains ongoing, as I will discuss later.

In many ways, the Pascua-Lama case was an early example of the kind of antimining activism that has become prominent over the last decade. Rather than appealing to incapacitated state governments, activists have started following the money, staging antimining protests against sources of investment, and targeting the empathy of consumers and investors on the other side of the world. The case of Intag, a predominantly agricultural subtropical valley of Ecuador, also demonstrates this shift in tactic. In the mid-1990s, local activists formed an antimining group called *Defensa y Conservación Ecológica de Intag* (DECOIN) and generated collective local opposition to a proposed copper mine by emphasizing the effects that mining would have on the regional watershed.[33,34] Once an antimining community had been consolidated, DECOIN then attempted to challenge the accuracy of Canadian company Ascendant Copper's stock offering prospectus on the Toronto stock market, thus preventing it from being listed. In 2009, a delegation from Intag traveled to Toronto to file a lawsuit against the company Copper Mesa and the Toronto Stock Exchange for financing threats and attacks on community leaders who were opposing the mine.[35] Facilitated by environmental NGO Acción Ecológica, these actions attempted to bring the power of the Canadian law and Canadian investor empathy against the mining company at a point when the Ecuadorian state was less willing or able to protect its citizens' rights to an unpolluted watershed. In other words, the global geographies of international activism—much of it driven by real or perceived threats to water—has arisen alongside and helped shape the global geographies of mineral investment.[8]

This alloyed waterscape also been shaped by growing international concern with sustainable development and responsible mining.[36] Once a refrain of environmental activists, references to sustainable development have been woven into mainstream corporate mining discussions since at least the formation of the Global Mining Initiative and the 2002 release of its landmark report *Mining, Minerals and Sustainable Development* (MMSD).[37,38] Although there is substantial debate over whether or not mining can ever be considered sustainable, given that it is by definition extracting nonrenewable resources,[39] the MMSD report deployed a 'soft' definition of sustainability that focused primarily on community–corporation relations, such as managing local expectations and building participatory monitoring mechanisms.[38] Surprisingly, the document made little

reference to water outside of comments on acid drainage. This changed in 2012, when the IIED released a follow-up document entitled *MMSD + 10: Reflecting on a Decade of Mining and Sustainable Development,* which highlighted water as the 'issue of the day,' listed as 'amongst the top three sustainable development issues for the next 10 years' (Ref 40, p. 20).

The MMSD and MMSD + 10 are not the only examples of international conversation around the relationship between mining and water, but they usefully illustrate the degree to which global mining governance has been shaped by demands for water made on the ground and around the world. This alloyed waterscape is profoundly social and will continue to evolve in relation to the global political context.

CONJUNCTURAL THEMES: THE NEW MINING WATERSCAPE

Corporate–Community Relations: The Ambiguity of CSR

At the end of his 2004 review of the 'contested terrain' of mining and the environment, Gavin Bridge noted that mining, although often 'derided as a mature, even anachronistic industry,' was finding itself 'in the vanguard of a halting, yet ineluctable, move toward increased CSR' (Ref 41, p. 247). From the current historical vantage point, in which the biggest corporate names in mining have fully developed CSR programs that form the glossy exterior of their public images, this tentative statement is a reminder of how ubiquitous CSR has become in a relatively short period of time.

The rise of CSR in the mining sector is closely tied to the convergence of two processes. On the one hand, social movements demanding the improvement or termination of mining operations began to form around the world, led by activists with environmental and social concerns. Many of these activists were alarmed by the threat that mining posed to water resources needed to support human life, agriculture, and regional biodiversity. On the other hand, there was a proliferation of nongovernmental organizations (NGOs) in the voids that were left by states reconfigured by neoliberalizing processes in the 1980s and 1990s.[42] These NGOs worked to propel the demands of activists into the international arena, pressuring transnational corporations to mitigate the negative impacts of mining. Emblematic examples of their work include the 'No Dirty Gold' campaign, led by Earthworks and Oxfam America,[43] and the anticonflict diamonds campaign, a coordinated effort spearheaded by Global Witness.[44] Much CSR programming was a direct response to such demands.[45]

An umbrella term, CSR encompasses a range of activities, including participatory mechanisms, such as community monitoring programs and local labor agreements; monetary compensation for damages associated with mining, paid to communities or directly to individuals; and corporate participation in the provision of traditionally public services such as education, health care, transportation, communication, and water supply. These programs are all voluntary. Multiple corporate and trade associations have formed and produced a welter of codes of conduct and principles,[a] but none of these are enforced.[21,40,46] At the heart of most mining companies' CSR programs from the early 2000s onward was the notion of a 'social license to operate' (SLO), which was alternately framed as an overarching goal to be attained *through* CSR and the set of corporation–community-negotiated regulations that formed the foundation *of* CSR.[38,47,48] In either case, water has been fundamental in communities' decisions to grant or deny companies a social license. To give a recent example, the Anglo American gold-copper-molybdenum mining project in the headwaters of the Bristol Bay salmon fishery in Alaska (the Pebble deposit) was not granted a SLO over concerns that an earthquake could cause leakage of acidic water and heavy metals from the mine into downstream salmon zones.[49]

But even setting aside the inherent heterogeneity of the 'community' that must grant or deny a SLO—and the challenges of determining who constitutes and has a right to speak on behalf of such a community[50]—the fuzziness associated with the notion of a social license makes it an unreliable tool for measuring the success of CSR projects.[51] Indeed, the results of CSR programs have not been clear-cut. If on the one hand CSR has improved the lives of subsistence farmers who might otherwise have lost their land and water without consultation or compensation, it has also rendered transnational capital a more insidious enemy. As Matthew Himley argues in reference to a local employment initiative at a Barrick Gold mine in Pierina, Peru, CSR can be a way to '*regularize* large-scale mining and ensure continued accumulation' (Ref 52, p. 395). Mining companies, once the archvillains of activist literature (such as the Newmont 'Newmonster' described by Marina Welker[46]), are now more ambiguous local presences.

In recent years, the CSR emphasis on obtaining a SLO has given way to a full corporate embrace of human rights. The MMSD + 10 notes that human rights, which in 2002 were considered 'too

ideologically weighty an issue ' (Ref 40, p. 17) have become a fundamental component of CSR discourse. The report attributes this shift to the release of the UN's Guiding Principles on Business and Human Rights in 2011. None of these principles, however, made reference to water, a topic that is all but unavoidable in the mining sector. Kemp et al.[3] have worked to explicitly clarify the complex relationship between water, mining, and human rights. They outline four ways in which water is a human right (legal, cultural, universal, distinct), identify the processes by which mining affects water quality or availability, and propose that attention should be focused on the ways that these transformations impinge on each of the four dimensions of the human right to water. This typology could be very useful moving forward, but at present, the human right to water has been taken up in a much more piecemeal fashion within existing CSR programs. Nevertheless, an increasing number of mining companies are facilitating regional water access and even supplying water directly to affected communities.[46,53]

Focusing on human rights has some advantages for mining corporations. In an important contribution to the discussion of water as a human right, Karen Bakker makes the argument that human rights are compatible with commodification and that using the language of rights against water privatization is neither conceptually coherent nor politically strategic.[54] Although others have responded with arguments about the practical utility of human rights for communities engaged in struggle,[55,56] Bakker's point is supported by the move within the corporate world to embrace (and even act as the guarantor of) human rights. Continuing in this vein, the International Council on Mining and Minerals has recently published a position paper entitled *Indigenous Peoples and Mining* that outlines the ways in which corporations should work to respect indigenous rights and implement the principle of 'free, prior, and informed consent' (FPIC). [57,58] Although this document makes little reference to water, it is nevertheless interesting to note that corporations are not only adopting the language of rights but also positioning themselves as the defenders of rights. In some ways, this stance obviates the role of the state while justifying the corporation as caretaker. This is hardly a new role for mining companies, which have a long history of providing paternalistic care for their workers,[59,60] but it is an *expansion* of corporate care beyond the labor force and into surrounding communities, rationalized in the language of universal rights.

What is the result of so much corporate investment in community well-being, especially in such a fundamental substance as water? It is worth emphasizing that in the everyday lives of water users, a supply of freshwater is better than no supply of freshwater, even when controlled by a foreign corporation. Acknowledging this fact, however, does not negate the long-term threats posed by privately controlled water supply.

Examinations of mining companies' apparently munificent participation in Peruvian water supply by Denisse Roca Servat,[61] Milagros Sosa Landeo,[62] and Jessica Budds[17] give some indication of what these threats might look like. In the city of Arequipa, where the mining corporation Cerro Verde has been hailed as a case of 'best practices' for its commitment to improving water supply in periurban areas, Roca Servat argues that water has been reduced to an economic rather than a social good, which has the effect of reproducing social divisions between citizens and subjects. In rural Cajamarca, where the massive open-pit gold mine Yanacocha has responded to *campesino* complaints of reduced irrigation water availability by supplying treated wastewater, Sosa Landeo contends that corporate involvement has put limits on *campesino* demands; the latter had been militating for a return of 'natural' (uncontaminated and untreated) irrigation water, and accepting the treated water implied renouncing their water rights and their ability to make future demands. Working across southern Peru, Budds highlights the spatial limits of water supply projects. Although communities geographically close to mining operations have received compensation from the companies, communities deemed beyond the risk zone have received none of these benefits, despite also experiencing reductions in water quality and quantity. In all of these cases, water was transformed from a universal right upheld by the state to a (symbolically, culturally, and spatially limited) palliative provided by a company.

The pernicious question that haunts all of these cases, moreover, is what will happen in the postclosure phase. Mines continue to pose serious threats to water resources long after their active lives are over, and the question left unanswered is who or what will ensure that the communities' water supply continues when the private companies leave.

State–Society Relations: Rights and Nationalisms

The relationship between mining and the state is characterized by a contradictory movement. On the one hand, the role of the state has been minimized, with transnational corporations increasingly performing such tasks such as recognizing rights and

providing basic services, as discussed above, but on the other hand, states are reasserting their presences in the mining sector in nationalist terms, tapping into a deep sense of historical injustice; centuries of colonial extraction, followed more recently by neoliberal extraction, have raised the nationalist ire of people around the world.[63,64] But state-led extraction can override community demands to as great or greater an extent as did their corporate counterparts. Water figures fundamentally in both of these movements, as a right being upheld (or not) and as a source of conflict between the nation-state and local/regional resource claims.

In the aftermath of intensive neoliberal restructuring that characterized the 1980s and 1990s, rising commodity prices in the early 2000s were taken as a boon by states attempting to rebuild strength and autonomy. Around the world, policies were enacted that directed more resource rents to national coffers. Dubbed 'resource nationalism,' this phenomenon has received attention from within the worlds of international relations and public policy[6,40,65–67] and from critical social scientists.[68,69] While most conversations about resource nationalism revolve around oil, a 2011 survey of industry opinion revealed that resource nationalism is also considered a primary concern for the mining sector.[47] The MMSD + 10 similarly identifies resource nationalism, alongside rising competition from emerging economies and climate change, as an important new pressure that is 'putting the challenges and solutions for sustainable development in mining in a new light' (Ref 40, p. 2).

Indeed, there is a connection between pressure from emerging economies and the rise of mineral-based resource nationalism. David Humphreys points out that seven of the world's 20 largest mining companies (by value of metal production) are based in emerging markets (Brazil, Chile, Mexico, South Africa, and Russia) and receive state support. This number would be greater if it included companies from emerging market origins listed on the London stock exchange, of which there are many.[6] More recent data, moreover, would have certainly included China, the rising star of the mining sector. China is unique in that it is simultaneously *driving* the global upswing in resource nationalism by contributing to global demand, *facilitating* resource nationalist agendas abroad by investing in mining operations in countries that have rejected western involvement, and *developing* its own resource nationalist agenda, often accompanied by processes of internal colonialism.[6,70]

What does any of this have to do with water? Although human rights, such as the right to water, are supposedly universal, political theorists have long noted that rights are generally upheld by states, creating a contradictory situation for 'stateless' people such as refugees, citizens of countries with weak states, and people living in regions with little state presence[71]—the latter of which is often the case in mining zones. But it must be underscored that strong states will not necessarily uphold human rights, as state mining corporations in contexts of resource nationalism make abundantly clear.[24,70] In Latin America, Eduardo Gudynas has coined the term 'neo-extractivism' to describe the ways that socially progressive states such as Bolivia, Venezuela, and Brazil are financing their progressive social programs with resource rents.[72] As in many countries, these states hold all subsoil rights, and, in theory, every national citizen has a claim on the rents derived from resource extraction, but the rights of national citizens to resource rents are often counterposed to the rights of communities threatened by large-scale extractive processes. Local concerns about water quality, quantity, or availability are easily disregarded in this fight for national resource sovereignty.

Given the tensions between national rights to resource rents and local rights to land and water, resource nationalism can develop in tandem with alternative sovereignty claims, particularly if the resource is located in indigenous territory, as has happened with the tar sands in Canada[73,74] and natural gas in Bolivia.[75,76] These processes are intimately related; as valuable subterranean resources are exploited by a state that undermines local water needs, communities are formed in the defense of water and other local resources. Such alternative sovereignties often invoke not only material water needs but also the meanings with which water is imbued in local histories and cultural practices. Inspired by work on the 'hydrosocial cycle,'[20] Rutgerd Boelens has coined the phrase 'hydrocosmological cycle' to understand the dynamic interrelationship between natural, social, and supernatural aspects of water in Andean societies, and the ways that these elements have been aligned in different regimes of government.[77] Although Boelens is focused on the water cultures of the Incan and Spanish empires, his work creates space to consider ontological friction around water in the contemporary moment.

Marisol de la Cadena employs the phrase 'sites of equivocation' to describe such ontological friction within anti-mining movements in Peru.[78] While environmentalists and left-leaning activists oppose open-pit mining on the basis of its biological and social impacts, indigenous people are also angered by

the threat posed to specific, sacred mountains known to house sentient earth-beings. The most notorious case of such 'equivocation' in Peru is closely linked to water resources. The planned expansion of the Yanacocha gold mine into the Cerro Quilish in the early 2000s met fierce resistance from local residents and environmental activists alike as this mountain houses both an aquifer that supplies water to the surrounding area and a local deity known as an *apu*, which is usually translated from Quechua as 'sacred mountain.'[30]

Indigenous rights and indigenous cultural knowledge have been increasingly at the heart of antimining protests. Recent developments in the Pascua-Lama conflict cited earlier exemplify this trend. While antimining mobilization in the Chilean Huasco Valley in the early 2000s pitted small-scale farmers against Barrick Gold, the reigns of the struggle have been more recently picked up by the Diaguita indigenous group, whose territorial rights were recognized by the Chilean government only in 2006. In 2009, Diaguita Huascoaltinos filed a petition with the Inter-American Commission on Human Rights challenging the land rights of the Pascua-Lama mine. This petition specifically identified reduction in glacier size and contaminated/reduced water supply as major threats to material and cultural survival. It also invoked the unique role of glaciers in Diaguita cosmology.[79] The same year, regional water authorities published a report stating that Barrick Gold was drawing water from unauthorized locations and causing damage to the Estrecho glacier through dust exposure. In response to both this report and pressure from the Diaguita Huascoaltinos, in 2013, the Chilean court fined the company 8 billion pesos (approximately US$16 million) and ordered a halt on mine construction. Pascua-Lama remains closed today, although Barrick continues its efforts to reactivate the mine, possibly in partnership with China's Zijin Mining Group.[80]

In sum, as nationalist resource agendas react to transnational plunder, subnational and regional conflicts emerge around threats to local resources, particularly water. Some of these struggles articulate alternative sovereignty claims or alternative 'hydrocosmologies,' but just how united are 'communities' in antimining projects?

New Challenges to Community: Artisanal and Small-Scale Mining

The tendency among academics and activists in the early 2000s to romanticize community or fall into the 'local trap' has been thoroughly critiqued.[50,81–83] Community, as many authors have now noted, is neither homogenous nor free from internal power dynamics, which often run along gendered and racial lines; it is difficult to bind and even more difficult to determine fair representation. From a celebration of 'community-based natural resource management,'[84,85] the conversation has shifted to explore malleable conceptions of community and the local level of governance. Recently, analysts have focused their attention on how interactions between those affected by extraction and those performing extraction are brought into being and given the appearance of stability to social categories such as indigenous tribes, corporations, and the state.[86,87]

One of the ways in which the notion of community has been challenged in the mining sector is through an increasing awareness that many 'community members' practice artisanal and small-scale mining (ASM). Although small-scale mining has been around for as long as mining itself, often undertaken in combination with small-scale agriculture, studies suggest that the number of ASM laborers has grown significantly in the last few decades. The most widely cited statistic comes from the ILO's 1999 report on ASM, which estimated that, worldwide, 13 million people were engaged in small-scale mining and that between 80 and 100 million people depended on small-scale mining for their livelihood (Ref 88, p. 4). The MMSD + 10, however, states that conservative estimates now put the number of artisanal miners at 20 million worldwide, with a realistic figure being closer to 30 million (Ref 40, p. 11). Banchirigah attributes the boom in ASM in Sub-Saharan Africa to the policies of the 1980s and 1990s. Structural Adjustment Programs left many unemployed and drove them into ASM, while the influx of large-scale mining and agricultural operations reduced the amount of land available for peasant farming.[89] This argument would likely also be applicable to Asia and Latin America, which saw similarly explosive numbers of ASM practitioners in these decades.

Held up against a narrative of extraction that pits corporate giants against noble communities, the idea that locals might be actively extracting, polluting, and self-exploiting is discordant. At the top of the list of concerns about ASM are environmental pollution and health risks, both of which are intimately connected to water use and disposal. Small-scale miners often work in alluvial zones or rely on water-dependent processes to separate valuable minerals from worthless rock. Artisanal gold miners, e.g., are notorious for releasing significant quantities of mercury into rivers and soils, where it can endure for centuries and make its way into residents'

bodies.[90,91] In Bolivia, small-scale tin miners use a mixture of xanthate, sulphuric acid, kerosene, and car oil to separate tin from pyrite.[92] But even if small-scale miners were to somehow avoid all chemical additions, mining would still have an impact on water resources by stimulating acid mine drainage. Although these processes take place on a much smaller scale than their industrial counterparts, small-scale miners rarely have the financial resources to take the kinds of environmental precautions expected of larger (and legal) operations.

Water concerns have thus been central to the ways by which development practitioners and other mining sector actors have approached ASM. Although in the 1980s, small-scale miners were hailed as 'rogue entrepreneurs,'[93,94] the focus has shifted toward the socially and environmentally deleterious aspects of ASM and potential technical and/or policy-oriented 'fixes' (e.g., providing mercury retorts to minimize contamination, guaranteeing individual mineral rights to bring ASM into the formal sector, focusing training efforts on women, etc.)[88,91,95] that would minimize water contamination by heavy metals and acid drainage. However, the emphasis on water is not limited to technocratic solutions. Recent calls for justice-oriented approaches that reimagine artisanal miners as potentially active participants in resource management strategies also center water as a key area of concern and collaborative governance.[96,97]

Perhaps surprisingly, transnational mining corporations have started to pay attention to ASM and its hydrological impacts. ASM was a primary focus of the MMSD + 10 document, and policy-oriented research reports from the late 2010s emphasize the need to foster 'positive interactions' between large- and small-scale mining operations. This was in part a response to rising confrontations between large- and small-scale mines over access to land, water, and minerals, with ASM practitioners claiming a right to practice what is perceived as a pathway out of poverty.[98] To mitigate such disputes, which often required state intervention, organizations such as the now-defunct CASM (Communities and Small-Scale Mining)[b] developed tools to help transnational corporations assess the status of ASM operations, negotiate with ASM stakeholders, and foster 'community development' with participatory planning methods.[99] The stagnation of CASM moved the topic of small-scale mining on to the corporate agenda, where it has been identified as a challenge to sustainable mining that might be better conceptualized as an opportunity rather than a threat.[40,100]

Increased awareness of ASM, especially its impacts on water, have had several implications for conceptualizations of 'communities' affected by mining. How such a community is understood—and, indeed, if it is considered a community at all—is in some sense shaped by its perceived commitment to protecting local natural resources. Public opinion of ASM tends to be extremely negative, with practitioners depicted as sources of uncontrolled environmental pollution.[101] This is the polar opposite of essentializing depictions of antimining community resistance. In fact, recognition of ASM provides a much-needed complication for theories of community resource governance. As Petra Tschakert's work, in particular, makes clear, recognizing small-scale miners as 'community stakeholders' implies shifting critical praxis to the period *after* dispossession and being open to a range of chronic environmental justice questions.[102] What does justice look like in a context in which economically, geographically, and racially marginalized people are struggling not for the end of extraction but rather for a larger share of resource rents, financial resources to improve their working conditions, or geological expertise to locate new deposits?

The distinction between clean and contaminated water as it moves throughout a mining zone makes possible a simplistic distinction between 'communities' that defend their resources in the face of extractive practices and 'rogue entrepreneurs' who participate in mining at the expense of the environment. It also makes possible an equally simplistic distinction between the modern, 'clean' mining practices of corporations and the retrograde, polluting practices of ASM. In practice, agriculture, ASM, and industrial mining are intimately connected through their shared water resources. This is demonstrated on the one hand by the historical dynamic between the rise of industrial mining, dispossession of local residents through loss or deterioration of land and water resources, and the escalation of small-scale mining. This dynamic has played out, e.g., in Ghana, where Ray Bush argues that small-scale mining (known regionally as *galamsey*) might offer a 'strategy of resistance' for farmers whose land and water rights were taken over by mining corporations.[103] But the relationship between industrial mining, agriculture, and ASM is also evident in the movement of water throughout mining zones; clean and contaminated waters flow together and create the (markedly inequitable) alloyed waterscapes in which actors must negotiate their water access. ASM is thus a central part of the ongoing dynamic of mineral extraction, inextricable from the community–corporation

relationship through which tales of dispossession are usually told.

DISCUSSION AND CONCLUSION

This review has explored the *alloyed waterscape* of mining, attempting to elucidate major shifts in global mineral relations and highlight the role of water in shaping these dynamics. A decade of comparatively high mineral prices, in interaction with widespread popular resistance to resource privatization and economic liberalization, has significantly altered the global extractive context. Invoking the scalar triad of transnational-, national-, and local-level governance to frame the analysis, this paper identified three conjunctural themes in the mining sector: a ramping up of CSR programs, which have increasingly drawn on the language of sustainable mining and human rights; a reappearance of the nation-state in the form of 'resource nationalism'; and a crisis of community brought about in part by the proliferation of ASM operations.

These three shifts are closely connected, each responding to changes in the global political economy, social and environmental movements and to one another, but most importantly, all three shifts are bringing about and responding to changes in water quality, quantity, and availability that are in turn triggered by mining activities. In the first case, CSR activities were developed by mining corporations in response to local demands for secure water access and are targeted toward water treatment and supply. In the second case, nationalist agendas, which themselves emerged in response to the threat of transnational resource extraction, often uphold national subsoil rights over local water rights, provoking local resistance, and alternative sovereignty projects. In the third case, the rise of ASM has had an adverse effect on water resources in ways that both challenged the notion of community and prompted increased corporate involvement in the form of ASM-related CSR projects. Water flows in and across scalar divides and analysts attempting to critically engage mineral extraction must consider these multiscalar hydro-social dynamics in relation to one another.

Examining the multiscalar relationship between mining and water conjuncturally begs the question: toward what does this conjuncture direct our attention in the near future? Here, I highlight three directions for future research. The first is one to which I have alluded at several moments throughout this paper: the politics of time embedded in the question of mine closure. Stuart Kirsch distinguishes between the 'politics of scale' (e.g., activists 'jumping scale' to access global solidarity networks) and 'politics of time' (e.g., activists demanding their right to 'free, prior, and informed consent' to prevent or delay the construction of a mine).[104] Attention to water dynamics has the potential to unite these two kinds of activism. Unwilling to respect political borders and legal boundaries, water moves mining confrontations beyond immediate concession areas and into a wider political sphere; at the same time, the fact that mines can continue contaminating water even decades after closure compels activists to look beyond the productive lifespan of the mine. At present, just as CSR projects and other forms of mining mitigation are spatially contained,[17] so are they temporally contained. There needs to be greater academic attention to the postclosure phase, including the ongoing biophysical impacts of mine drainage and the social impacts of job loss, which in some places is connected to the rise of ASM (e.g., see Bolivia's mining cooperatives[105]).

Second, there is a distinct need for detailed empirical work on ASM that situates it within global relations of power. ASM is neither peripheral to nor isolated from industrial mining, with all its attendant political, economic, and socioenvironmental relations, and the academic literature ought to reflect that fact. Notwithstanding some excellent contributions from anthropologists, geographers, and other social scientists committed to exploring this complicated field,[106–108] there is room for significantly more. This work should move beyond the technological and policy fixes recommended by industry consultants, who currently produce the most research on ASM. Most importantly, critical literature exploring the historically sedimented *meanings* associated with small-scale mining (beyond being entrepreneurial or poverty-driven) has not yet been forthcoming. How does contemporary ASM relate to historical processes of agrarian change, proletarianization, and urbanization? In what ways is it unique to the current conjuncture?

Third and finally, the uncertain rise of China will almost certainly have repercussions on many of the dynamics discussed in this paper. Chinese investment in resource extraction in Africa, Asia, and Latin America has spurred a welter of academic and popular discussion about ongoing extractivism under shifting imperial powers.[109–112] But although the processes behind this investment are becoming clearer, the impacts remain murky. To what extent has the rise of China actually transformed global

geopolitical relations? How does Chinese investment affect processes within receiving countries, such as nation-building and regional conflict? How does water feature in these transformations? The implications of both fledgling resource nationalisms nurtured in China's shadow and the discursive panic over the 'new world order'—much of which contains more than a whiff of sinophobia—need to be explored in depth.

All of these points are poised to become more salient in the near future. Whatever transformations they bring about at the mining–water nexus, it is certain that the changes will be multiscalar, multisectoral, and fundamentally inseparable.

NOTES

[a] Examples of such codes of conduct and principles include the ISO 14000 (a family of environmental standards established in 1996), the Equator Principles (risk management framework for socially and environmentally sustainable investment, established in 2010 and revised for the third time in 2013), and the Global Reporting Initiative (guidelines for corporations wishing to monitor and make public their social and environmental impacts, established in 1997 and revised for the fourth time in 2015).

[b] The short-lived CASM grew out of discussions led by the Global Mining Initiative in 2001, was initially housed at the World Bank, and subsequently moved to DFID. For more information, see Hilson and McQuilken (2014).

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