Universiteit Leiden
The Netherlands

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Fisher, E.; Luning, S.; D'Angelo, Lorenzo.; Araujo, C.H.X.; Arnaldi Di Balme, L.; Calvimontes, J.; ... ; Twongyirwe, R.

Citation
Fisher, E., Luning, S., D'Angelo, L., Araujo, C. H. X., Arnaldi Di Balme, L., Calvimontes, J., … Twongyirwe, R. (2021). Transforming matters: sustaining gold lifeways in artisanal and small-scale mining. *Current Opinion In Environmental Sustainability*, *49*, 190-200. doi:10.1016/j.cosust.2021.06.010

Version:	Publisher's Version
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Downloaded from:	https://hdl.handle.net/1887/3264220

Note: To cite this publication please use the final published version (if applicable).

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Current Opinion in Environmental Sustainability

Transforming matters: sustaining gold lifeways in artisanal and small-scale mining☆

Eleanor Fisher[1,2], Sabine Luning[3], Lorenzo D'Angelo[2], Carlos HX Araujo[4], Luigi Arnaldi de Balme[5], Jorge Calvimontes[6], Esther van de Camp[3], Lúcia da Costa Ferreira[6], Cristiano Lanzano[1], Luciana Massaro[6,7], Alizèta Ouédraogo[5], Januária Pereira Mello[6], Robert J Pijpers[8], Nii Obodai Provençal[9], Raíssa Resende de Moraes[4,7], Christophe Sawadogo[5], Marjo de Theije[7], Giorgio de Tomi[4], Margaret Tuhumwire[10] and Ronald Twongyirwe[11]

Growth strategies in mining regions promote gold extraction based on industrial mining, associating Artisanal and Small-scale Gold Mining (ASGM) with persistent informality. Against this background, we consider how to approach transformations to sustainability in ASGM. Acknowledging how problematic this topic is for sustainability debates, given how ASGM is associated with a host of environmental and social problems, we argue that a justice lens demands we confront such challenges within the global politics of sustainability. This leads us to review advances in the study of ASGM, linked to debates on extractivism, resource materialities, and informality. We use the notion of gold lifeways to capture how the matter of mining shapes different worlds of extraction. We argue that consideration of the potential for transformations to sustainability needs to be grounded within the realities of ASGM. This necessitates giving value to miners' knowledge(s), perspectives and interests, while recognising the plurality of mining futures. Nevertheless, we conclude that between the immediacy of precarious work and the structural barriers to change in ASGM, the challenges for transformation cannot be underestimated.

Addresses
[1] Nordic Africa Institute, Box 1703, Uppsala SE-75147, Sweden
[2] University of Reading, Reading RG6 6AR, United Kingdom
[3] Leiden University, P.O. Box 9555, Leiden 2300 RA, The Netherlands
[4] NAP Mineração, University of São Paulo, São Paulo, SP 05508-030, Brazil
[5] Institute for Social Research in Africa, Secteur 22 Zogona 06 BP 9325, Ouagadougou, Burkina Faso
[6] NEPAM, Universidade Estadual de Campinas (UNICAMP), 155, Campinas, SP, 13.083-867, Brazil
[7] Vrije Universiteit Amsterdam, De Boelelaan 1105, Amsterdam 1081 HV, The Netherlands
[8] University of Hamburg, Edmund-Siemers-Allee 1, West (ESA W), Hamburg 20146, Germany
[9] Nuku Studios, 13 Nme Lane, Airport Residential Area, Accra, Ghana
[10] Environmental Women in Action for Development, P.O. Box 883, Entebbe, Uganda
[11] Mbarara University of Science and Technology, P.O. BOX 1410, Mbarara, Uganda

Corresponding author:
Fisher, Eleanor (eleanor.fisher@nai.uu.se, e.fisher@reading.ac.uk)

Current Opinion in Environmental Sustainability 2021, **49**:190–200

This review comes from a themed issue on **Transformations to sustainability: critical social science perspectives**

Edited by **Eleanor Fisher, Emily Boyd** and **Eduardo Brondizio**

For a complete overview see the Issue

Available online 26th July 2021

Received: 22 October 2020; Accepted: 18 June 2021

https://doi.org/10.1016/j.cosust.2021.06.010

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Introduction

Critiques of the notion of progress based on continuous economic growth situate ecological destruction as a defining feature of modern society [1]. In this line, it is argued that to address environmental crisis there is an imperative to fundamentally change the way people live on earth, transforming human relations to nature [2]. Hence, sustainability debates give attention to the need for change of a scale, speed, and extent that is transformative for sustainable societies. Both the climate crisis and the Covid-19 pandemic have fuelled these calls for transformative change, including through identification of how the social sciences and humanities may contribute to a more egalitarian knowledge and politics of transformation [3•,4••]. In this line, attention to global environmental change has led an expanding body of literature to explore

☆ Given her role as Guest Editor, Eleanor Fisher had no involvement in the peer-review of this article and has no access to information regarding its peer-review. Full responsibility for the editorial process for this article was delegated to Emily Boyd.

the characteristics of transformation, how it can arise, and whether it can be just and equitable [5•,6••,7,8•,9•] (see Fisher *et al.*, *Introduction*, this special issue). Beyond academia, growing weight is given to transformation within international policy, including through the United Nations' (UN) 2030 Agenda on Sustainable Development 'Transforming our World' [10].

Mineral extraction contributes to global environmental change, with Artisanal and Small-scale Gold Mining (ASGM) playing a role within larger extractive processes. The term ASGM commonly refers to the extraction and processing of gold through manual or partially mechanised techniques, although its scale and intensity (capital and technology used, volumes mined) is increasing. ASGM occurs in at least eighty countries in the Global South. Data are notoriously weak [11,12],[1] but approximately 90% of all employment in gold mining and 20% of global gold production is based on small-scale extraction [12,13]. Put another way, estimates suggest 44.75 million people are directly and 134 million indirectly dependent on Artisanal and Small-scale Mining (ASM); around half are involved in ASGM [12].

In countries across the Global South, national growth strategies endorse extractives-led development that privileges industrial large-scale gold mining. Worldwide, the gold industry is witnessing rapid change, incorporating new actors, technology and sources of capital [14••]. Such processes redefine temporal and spatial dynamics [15••,16] and contribute to the flows, movements and obstacles that disrupt and re-make worlds of extraction [17•]. We use the term 'gold lifeways' to focus on the 'unruly edges' [18••] of gold extraction, where informality is useful for the global supply chains that incorporate up to 20% of gold production from ASGM [12,19]. Gold lifeways gives expression to the situated, heterogeneous character of ASGM. Lifeways can be both precarious and a source of (temporary) stability, providing footholds towards futures constructed in the present using available symbolic and material capital. The notion of gold lifeways extends analysis of ASGM beyond either a resource logic or characterizations of informality; instead, lifeways capture the character of an occupation where people seek freedom and agency to create their own futures, with the matter of mining giving shape to diverse worlds of extraction. Our premise is that this can open a window for engaging with and unpacking the idea of 'transformations to sustainability' in ASGM.

In such complex, dynamic contexts, the value of (imported) models of change based on a single, objective view of 'the problem' is questionable [20]. Leach, Scoones and Stirling [20] stress the need to pay attention to plural perspectives and to the narratives framing sustainability. Such narratives incorporate judgements about the temporalities of change, about which issues are important; about the prioritisation of some solutions over others; and about whose interests should be included in, or excluded from, decision-making processes. Sustainability narratives pertinent to ASGM reflect stark asymmetries of knowledge and power. All too often, these narratives reinforce negative, homogenising and dehumanising stereotypes that situate miners as environmental pariahs and social deviants [21••,22]. Within policy, expert-led knowledge and technical solutions gain credence at the expense of opportunities for gold miners' voices and interests to inform debate. This contributes, unsurprisingly, to a highly contested knowledge arena.

In this article, we take the basic starting point that one cannot expect to transform the world without understanding it. Hence, we situate gold mining within a broader field of study on mining and extractivism to consider what theoretical and methodological approach is relevant for addressing transformations to sustainability in ASGM. Intending to pay attention to plural perspectives, we address how to understand better what futures miners anticipate and wish for, acknowledging the spatially and historically situated character of such anticipation. Disregarding miners' perspectives reinforces critical barriers to sustainability and limits scope for fostering deliberative sustainability transformations. Motivated by a three-year transdisciplinary project for which co-authors are team members, 'Gold Matters — Transformations to Sustainability in Artisanal and Small-scale Gold Mining, Transregional and Multi-Actor Perspectives'[2], this overview will lead us to reiterate the value of transdisciplinarity, drawing from our own experience as a team.

In seeking to mobilise anthropology and allied disciplines for politically relevant modes of engagement [23•], we recognise that addressing 'transformations to sustainability' in ASGM is complex, perhaps even an oxymoron [24]. Moreover, as Kirsch [25••] argues, 'sustainable mining' can be a corporate strategy used to conceal harm and neutralise critique [also 26]. When considering ASGM, what constitutes gold as a resource and how it can be sustained is not a given. According to a techno-scientific logic, gold is a finite, non-renewable resource whose reserves are being depleted [27,28]. However, ethnographically, anthropologists problematize this view of gold as an inert, fixed resource by demonstrating how cosmology mediates people's relationships to gold [29,30,31•,32••]. Beyond this, and in the context of

[1] For data on ASM see DELVE, a global online data platform supported by the World Bank Group and Partnership for Capacity Building in Africa (PACT). https://delvedatabase.org/about (accessed 2021-04-12).

[2] Co-authors of this publication are members of the Gold Matters project, which explores whether a transformative approach towards sustainability can arise in ASGM. See: http://gold-matters.org.

governance arrangements and industry dynamics that reinforce informality, ASGM is often characterised as the epitome of unsustainable production. It is widely associated with environmental destruction, deplorable working conditions, and negative socio-economic and health impacts; it also contributes 38% to global mercury emissions [33]. We do not shy away from these issues and acknowledge just how problematic they can be when addressing questions of sustainability.

Our orientation, and why we consider ASGM an important issue for debates on transformations to sustainability, is pragmatic. Many millions of people in the Global South depend on gold mining, and with high global demand for gold, coupled with miners' capacity to exploit marginal reserves, ASGM will continue for years to come. Whether addressing critical barriers to sustainability involves transition to more sustainable mining practices or to non-mining livelihoods, a justice lens demands that we debate such problematic challenges within the global politics of sustainability.

To develop this line of argument, we turn in Section 'Mining, extractivism, and materiality' to consider how literature relevant to transformations to sustainability addresses mining and extraction. Then, in Section 'ASGM, informality, and formalization', we capture debates on informality in ASGM, outlining a dominant approach to sectoral development known as 'formalization'. Section 'Gold lifeways, transformation, and sustainability' gives attention to how the notion of gold lifeways can be used to address transformations to sustainability in ways that embrace resource materialities. Finally, 'Conclusions' are followed by 'References and recommended reading', incorporating an annotated bibliography that highlights literature of value to our main line of argument.

Mining, extractivism, and materiality

We start with the observation that work on mining or mineral resource extraction characterised by a 'transformative turn' is limited. This may reflect how studies have focused on transitions in systems deemed fundamental to societal functions and contributing significantly to carbon emissions (energy, transport, housing, and agro-food) [7,34]. Of course, human societies are profoundly dependent on metals, minerals and mining [35••], but this gap in research is only recently changing, notably through attention to energy transition and an expanding demand for minerals and metals in low-carbon technologies [36,37]. Bearing this shortcoming in mind, we choose to delimit three broad areas of scholarship that we consider relevant to advancing the discussion.

The first area relates to work on sustainable mineral use and mining industry development. In the context of debates over mineral resource scarcity and exhaustion, sustainability scholars have emphasised the need for international governance mechanisms to ensure the availability of minerals and the equitable distribution of mineral wealth [38–40]. This tallies with science-policy on climate change that addresses transformation pathways in mining [41,42], although the tone is of a depoliticised 'voice of industry', with weak attention to the social and political drivers of transformation. From a development perspective, where these drivers are more apparent, studies consider mining and change necessary to meet the Sustainable Development Goals (SDGs) but do not address transformation *per se* [43•,44]. Casting the net wider, research shows how mining heritage cities can transition in (un)sustainable ways [45,46]. Transitions literature also addresses the implications of a boom in demand for minerals and metals due to a new renewables' infrastructure [47]. Studies identify a 'decarbonisation divide' between the Global North and South, encompassing issues of exploitation and injustice [37,48,49].

A second area of scholarship relates to extractivism and transformation. As regards mining, extractivism refers to an acceleration of extraction to fulfil global demand for metals, minerals and energy in ways imbued with a specific resource logic (endowing natural resources with a dominant rationale for framing human relations to the non-human environment that excludes other kinds of relations or value [50••]). Neo-extractivism distinguishes post-2000 extractivism in Latin America from an earlier neoliberal form where the export of raw materials was exclusively in the hands of transnational corporations [51]. Neo-extractivism incorporates a welfare model of development in which progressive governments invest revenues in social programmes and infrastructure to benefit populations. It is nonetheless argued that neo-extractivism remains premised on the same extractivist relationships to natural resources, with continuing negative environmental and social impacts [52]. While extraction-led development holds many promises [53] the negative impacts of extraction provoke conflict and formidable struggles between people, state and transnational corporations [e.g. Ref. 54]. This stimulates the search for alternatives, especially in Latin America, as documented in work on social movements as agents of transformation. Examples include Escobar's 'designs for a pluriverse' [55•] and Gomez-Barris' decolonial exploration of 'terrains of potential' [56•]. Of note, too, is Temper *et al.*'s [57•,58] work on resistance and transformations to sustainability.

Gold mining and gold are bound to the development of capitalism, transforming nature through technological innovation [59], and the creation of racialized regimes of labour exploitation and gender inequality in the conversion of surplus value [60•,61••]. This legacy reminds us that 'transformations to sustainability' are not an innocent endeavour disconnected from colonial and imperial pasts,

or indeed ideas of modernity and visions of progress. It is therefore worth dwelling on the notion of extractivism to inform our continuing discussion. Szeman and Wenzel [50••] argue that the term extractivism is either used narrowly, referring to a physical process of extracting natural resources, or is expanded to include ideological rationales that motivate either extraction or its consequences and which reference a wide range of areas encompassed by capitalism and the erasures (human and non-human/other-than-human) generated by extraction [60•].

Used well in an expanded sense, Yusoff [61••], creates a history of minerals and bodies rendered extractable through racialized regimes of colonialism and slavery. She comments on the universal human agent of ecological destruction signalled by the term 'Anthropocene' and indicts geology as constitutive of the environmental crisis. Likewise, to provide a contrasting example, Povinelli [62••] re-theorizes questions of power by focusing on late liberal governance and the extractive economies of settler colonialism in Australia. Through the concept 'geontologies' and a mode of power conceptualised as 'geontopower', Povenelli shows how settlers' categorization of extractive landscapes as 'Nonlife' served to ignore and belittle the different categorizations of 'Life' and 'Nonlife' applied in Aboriginal societies.

Szeman and Wenzel [50••] argue the notion of extractivism requires careful use — as demonstrated by the work of both Yusoff and Povenelli — because it can loosely connote everything through which value is generated for capitalism. In this blanket sense, without teasing out aspects of capitalism or relations described as extractivist, it becomes analytically unhelpful. Thus, better to focus extractivism on naming a human instrumentalism of non-human nature, the use of which is only a means towards human ends (and not all humans). In so doing, keeping both materiality in view, and the social relations constellated around specific resources, helps to capture the 'itineraries of material flows . . . [and rifts, geographic, social, metabolic/ecological] . . . that create disjunctures in the value extracted from, produced by, and returned to, sites of extraction and the lifeworlds in which they are embedded' [20, p. 510]. As Richardson and Weszkalyns [63] propose, giving attention to the character of matter and of infrastructures of extraction facilitates interrogation of the logics that perpetuate natural resource exploitation [64].

This leads to a third area of scholarship within literature on the anthropology of ASGM.[3] Consistent with our argument, we zoom in on studies that convey the strength of ethnography for understanding resource materialities. They bring into view the material conditions of social and cultural life by rethinking received dichotomies between the human and non-human, society and nature, including what has agency or is acted upon. We note here Ingold's [65] plea to 'take materials seriously' (p. 31) as processual and relational, rather than having fixed attributes. Ferry does this well for gold [66•].

Ethnographic case studies address materiality and the embodied dimensions of mining [22,67•,68]. Examples are illustrative (including studies by this article's co-authors). Luning and Pijpers [69•] explore the 'in-depth geopolitics' of pit mining in Ghana, in which 'a socio-political field of relations anchored into an underground of geological structures' (p. 762) echoes the governance arrangements that frame access to gold in mining concessions. Luning [70] expands the material dimensions, focusing on the politics of knowing the underground and valuing subterranean extraction. Focusing on river dredging for gold in Bolivia, Salman [71••] locates materiality within human action and describes 'how local techniques, materiality, infrastructure, and operation modes, together with histories and memories thereof, influence the way alluvial mining in Bolivia materializes' (p. 1125). Also in the Amazon basin, the research of scholars led by de Theije [72–75] pays close attention to materials within a 'socio-tech' approach to mining.

Through ethnography, De Theije [76,77] and De Theije and Luning [78] portray the transnational character of mining, and the geographical movement of matter through the mobility of people, gold and goods. Attention to how mobility and technological innovation stimulates wider transformation also brings social and material arrangements to the fore, as described by Lanzano and Arnaldi di Balme [79,80••] and by Robertson and Farrelly [81]. Finally, a wealth of cosmological understanding points to the power and capricious agency of gold and spirits of the underground, requiring rest, care, protective charms, or libation [29,30,31•,32••,79, 82•]. In these ethnographic studies, 'the material' is not simply a condition for social organisation but integral to the analysis, with the matter of mining given shape through miners' skill, knowledge, practices, bodies and mobilities within lifeways that lend nuance to an understanding of the heterogeneous and historically situated character of ASGM.

In our view, different aspects of the above literature provide entry points into constructing the relationship between ASGM and transformation. Consideration of what is to be sustained, how transformation can occur, and whom will benefit are political and justice issues, as attention to extractivism underlines. Bringing materiality to the fore can help to reveal how mining and sustainability dynamics are socially and materially shaped, as well as being historically situated and contextually rooted.

[3] Broader review of the anthropological literature on ASM and ASGM is beyond this article's scope [see Refs. 35••,120•,121•].

Attention to ASGM dynamics leads us to turn to issues of informality.

ASGM, informality, and formalization

When considering transformations to sustainability in ASGM, the issue of informality, and how governments address this through 'formalization' (integration into the formal legislative, regulatory, and economic system), needs explaining.

Broadly, across the Global South, ASGM is entrenched with limited government recognition or regulation [83]. Indeed, informality and illegality maybe the only possibilities for miners because national mining laws are inappropriate for ASM or, more commonly, suitable laws remain unimplemented.

Analysing why ASM has been overlooked by African governments over four decades, Hilson and McQuilken [84•] argue that environmental, social and related problems are expressions of persistent informality, underpinned by sector-specific interventions that are disconnected from wider development planning. Coming into play — in Africa and other continents — are national growth strategies promoting industrial mining. This generates mineral rents but negates ASGM's value for employment and local economies [19,85,86].

While many studies focus on the role of the state in relation to informality, Geenen and Verbrugge [19,83,87] draw attention to how informalization is inherent in the way international mining capital seeks cheap and flexible labour to overcome persistent crises of accumulation. As they underline, the ubiquity of outsourcing and subcontracting in industrial gold mining challenges a dualistic perspective (i.e. treating industrial gold mining as 'formal' and ASGM as 'informal'). This leads them to argue that informalization is a systemic response to sector challenges with respect to mineral scarcity, labour costs, and local resistance. In effect, capitalism today perpetuates the structural characteristics of informality by not requiring the rationalisation of labour and extraction [*c.f.* 18••]

From a different perspective, what is referred to as 'informality' exposes the situated and expansive character of ASGM in mining regions. In this vein, De Theije [88] argues that seeing informalization in Brazil as merely a systemic response to the growing scarcity of gold ore and the reduced activity of industrial mining misses how 'informal mining is the oldest and most flexible form of gold mining that was meaningful and workable under different political winds and economic waves' (p. 119). Tubb [89••] makes a related observation on *rebusque* ('shifting')[4] in Colombian ASGM: 'seen from below, [it] encompasses and surrounds the formal sector . . . becomes the dominant economy, and the formal economy is merely a normative project' (p. 108). Jonkman [90] adds for Colombia that informality stimulates 'bottom-up' state making, appropriating the paraphernalia of officialdom, including within the cultural politics of the underground [91••].

The notion of frontier has been used to elaborate on the worlds of extraction that are labelled 'informal'. It helps interrogate how, where the state is weak, as Werthmann and Grätz [92] explain, 'artisanal mining springs up and creates new communities, new forms of bonding and alliance, and new divisions and hostilities, or new forms of integration and conflict.' (p. i). Attention to these issues leads Pelluso [82•] to explore resource frontiers in which labour practices, property relations and secret knowledge create resource territories. In contrast, Luning and de Theije [93•] conjoin the notions of frontier and border to understand the dynamic between governance practices and people's action, exposing identity politics and transnational mobilities. Taking a different tack, Bryceson and Geenen [94••] examine an occupational frontier to demonstrate how collective occupational identity and professional rule-making create scope for self-governance. Elsewhere [95,96], Bryceson and colleagues argue the mining frontier encourages egalitarian democracy. A thread running through all these studies is attention to what happens within a frontier where people seek freedom and agency to create their own futures [16].

Returning to a governance view of informality, while remember this larger picture on worlds of extraction within mining frontiers, the paradigm of 'formalization' goes to the heart of policy reforms across Asia, Latin America and sub-Saharan Africa. Reforms have sought to regularize ASM by bringing it into the legal sphere, with emphasis placed on securing mineral titles and permits. Being formalized acts as a catalyst for enterprise development, finance, environmental protection, gender empowerment, and improvements in pay, health, and well-being [e.g. Ref. 97•]. Over three decades, multilateral institutions, non-governmental organisations, industry bodies, and miners' associations have generated practical action aligning with this orientation.

Formalization contributes to sectoral development and enables some miners to secure benefits. However, evidence points to unevenness of impact. Here we loop back to ASGM being a way of organising worlds of extraction. Studies identify formalization successes [11,97•,98], but a

[4] Tubb [89••, p. xvi]: 'shifting' 'aims to capture the temporary, contingent, creative, and mobile world of informal work represented by *rebusque*.'

wealth of research also documents limitations. For example, through continued informality in labour practices [17•,62••,68,69•,72,99,100], gender exclusions [101•], state weakness [102,103], and complex exclusions [104••] including as a result of environmental policies [105–107]. Studies connect ASM to the SDG agenda [12,43•], identifying barriers due to informality [108••], although this may relate to the inappropriateness of a target-driven SDG approach for ASM [109•].

The many issues identified in research on formalization, point to how ASGM has its own embedded dynamics and rationalities that are masked by sweeping reference to 'informality'. The drive to formalize ASGM demonstrates benefits for come groups of people in certain contexts. Nevertheless, its shortcomings are apparent. Typically formalisation is based on a short-term development logic and reinforced by project-oriented development finance, in contrast to approaches to change that encompass a wider vision for sectoral reform, and public policies and finance that facilitate the sustainable development of ASGM in ways that are of genuine benefit to the people whose lives depend on it. As well as bringing into view the need to address structural barriers to sustainability, this underlines how important it is to draw the perspectives of miners to the fore.

Gold lifeways, transformation, and sustainability

We bring together our review on gold mining, extractivism, and informality to consider how conceptualisation of 'gold lifeways' permits us theoretically to approach transformations to sustainability in ASGM.

Used here, 'lifeways'[5] are neither a synonym for livelihoods nor a way of connecting to sustainable livelihoods debates. The term owes a debt to Tsing's [18••] analysis of international commodity chains based on Matsutake mushrooms following a 'white gold' rush in 1980s Oregon. As for Matsutake, salvage accumulation incorporates sites within and outside capitalism, those involved may associated their work with freedom. Tsing's [18••] call to 'watch the unruly edges' (p. 20), focusing on precarity to understand capitalist destruction and collaborative survival, strikes a chord for reflecting on transformations at the 'unruly edges' of gold extractivism, where informality is useful for gold supply chains [14••]. As Tsing observes, it is possible to amass wealth within capitalism today without rationalising labour and raw materials. Important instead, she argues, are acts of translation across varied social and political spaces ('patches') that draw one world-making project into another to make accumulation possible (p. 62). This applies *par excellence* to gold lifeways in ASGM.

[5] Archaeological, anthropological and sociological research in North America has used the concept of lifeways.

Latour *et al.* [110] discuss avoiding 'grand narratives' when approaching capitalist enterprise and the (un)making of human — non-human ecologies. Likewise, we reject a view of capitalism and mining based on a singular global history [111]; we see value for thinking on transformations to sustainability in exploring ethnographically how the extraction and mobility of gold, people, and things emerges through different constellations around the world.

Gold lifeways bring together all the elements within gold's transformation from geological matter to 'pure' gold; from mine sites to markets and beyond. Global gold prices create a dynamic: in boom times, new mining areas are opened and old areas are reworked; as prices fall, miners either remain or abandon sites [32••,72,112]. Entwined with the booms and busts of gold markets are other temporalities (e.g. cycles of production; seasonality), and their construction, manipulation and dissonances [15••]. Nevertheless, ASGM can appear in the moment, as people seek to create and imagine their own (unpredictable) futures [16]. In such processes, cosmologies are revealed in notions of luck, time, danger, secrets, and gold's agency [30,32••].

People may enter mining with little experience, but this is gained as occupational transformation occurs [95]. Whether through ore drilled from a rock face or placer deposits panned in a wetland, miners become experts at extracting, processing and trading gold, holding embodied knowledge of underground and overground matters [70,113•]. Forms of organisation establish norms and rules, tenure rights and access arrangements, enabling miners to work together and negotiate conflict [69•,72]. Regional mobilities generate multi-ethnic, transnational arrangements and prompt identity politics [78,93•,114]. Mobility also stimulates technological innovation and professionalization, with experts, knowledge, skills, and materials moving between mine sites [77,78,94••,115]. Investment in equipment and innovation changes production levels and environmental impacts, for better or worse. Extraction, processing, human provisioning, and the sale of gold requires fuel, electricity and transport infrastructures. As references throughout this review highlight, ASGM takes varied forms in mining regions. Hence, 'translation' enables gold to be traded on distant markets as a capitalist commodity (that may end life as a gift).

Put abstractly, what we are describing is an assemblage of elements that influence one another in a manner that is open-ended, not fixed or bound [116,117]. This assemblage includes human and non-human entities ('real' and otherwise; human and non-human/other-than-human), entangling the social and material together in encounters that stimulate transformation. This is dynamic, 'assemblages don't just gather lifeways, they make them'

[18••] (p. 23). An important issue is how an assemblage becomes greater than the sum of its parts, as we seek to encapsulate by exploring gold lifeways.

We come to the question of whether and how, within a highly dynamic occupation, gold lifeways can be transformed, or transform themselves, to generate sustainable futures. Materiality associated with the making and imagining of resources conditions understandings of past, present and future [118]. Hence for us, addressing issues of transformation lies in paying attention to gold lifeways as the locus where miners' seek the freedom to imagine their own futures. To transform worlds of gold extraction, necessitates gold miners' knowledge(s), perspectives and interests being valued in addressing sustainability. This may appear self-evident, but it is far from the case within the political realities of ASGM.

Transformative action also requires attention to structural dimensions that play out within gold lifeways. Here one cannot be naïve. When considering 'transformations to sustainability' in ASGM, a lesson from formalization experiences is just how entrenched are structural barriers to progressive visions of an inclusive mining sector, recognising its significance for those whose lives and livelihoods depend upon it, and how weak are public policies to address ASGM's many sustainability challenges. The best we can suggest is that a rounded understanding of sustainability dynamics in local contexts may permit windows of opportunity for transformative change to be grasped when they open up.

On a final note, to know the world making of miners and to understand ASGM dynamics in mining settings is challenging. In this respect, we find value in transdisciplinarity, bringing together interdisciplinary perspectives and incorporating non-academic knowledge and ways of framing transformations to sustainability. For us, methodologically, the need to co-labour [119] with miners to understand their worlds of extraction and the challenges and opportunities for sustainability transformations becomes critical. Co-labouring foregrounds multiple perspectives, since different people look with different eyes based on expertise, sensitivities and interests. A strength of a transdisciplinary approach is it enables researchers to engage with ASGM and sustainability issues in diverse and holistic ways. This requires reflexivity and acknowledged positionality on the part of researchers, including over the risks taken by miners in the conduct of research and the uses of knowledge.

Conclusions

This review has examined recent advances in the study of small-scale gold mining to ask what theoretical and methodological approach is relevant for addressing transformations to sustainability in ASGM. Theoretically, we have intersected the notion of transformations to sustainability with that of gold lifeways, giving expression to mining matters, while methodologically we have emphasised the value of a transdisciplinary approach. For meaningful transformation to arise and to change practices within the underground, addressing transformations to sustainability must necessarily foreground miners' perspectives and acknowledge the plurality of mining futures in different worlds of extraction.

Funding

This work was supported by the Belmont Forum and NORFACE Joint Research Programme on Transformations to Sustainability, co-funded by DLR/BMBF, ESRC, FAPESP, ISC, NWO, VR, and the EU through Horizon 2020 (grant number: 462.17.201) under the project 'Sustainability Transformations in Artisanal and Small-scale Gold Mining: Trans-regional and Multi-Actor Perspectives' ('Gold Matters') (2018–2021). Eleanor Fisher and Cristiano Lanzano acknowledge the Nordic Africa Institute for financing open access publication. All co-authors from NEPAM, Universidade Estadual de Campinas (UNICAMP) and the Centre for Responsible Mining, Universidade de São Paulo, Brazil, acknowledge financial support from FAPESP (grant numbers 2018/50033-6, 2020/07985-6, 2019/09709-9).

Conflict of interest statement

Nothing declared.

Acknowledgements

We would like to acknowledge the gold miners, members of mining communities, local government officials, and representatives of non-governmental organisations with whom transdisciplinary research has become possible and in particular those individuals who have been willing to share their working lives, workplaces, ideas and knowledge with us, including in circumstances of surveillance and political sensitivity over mining activities. In addition, we are grateful to Professor Emily Boyd and Professor Gavin Hilson for peer review comments to help us improve the draft; we of course remain responsible for all errors.

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