CHAPTER 5

Technological Innovation and Structural Change

Boris Verbrugge

Chapters 3 and 4 were devoted (almost) exclusively to gold mining. Yet gold mining is only one stage (albeit an important one) in gold production, aside from exploration, processing, refining, and recycling (Mooiman et al. 2016). In this chapter, we will zoom in more closely on these different stages, and the changing constellation of actors involved in them. As mentioned in Chapter 2, given the materiality of gold as virtually indestructible, it might be more appropriate to consider gold production as a cycle rather than a chain. Throughout this cycle, technological innovation is driving change. Rather than specifying the technical details of such changes, this chapter aims to provide a broad overview of general trends, so as to allow us to understand how particular gold mining crystallizations respond to such trends.

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5.1 Exploration

5.1.1 Technological Innovation

Exploration is aimed at identifying ore deposits that can be profitably mined. Traditional exploration methods, such as those used during the American gold rushes of the nineteenth century, typically involve panning for gold in creeks and riverbeds, and following veins into the surrounding hills. While many ASGM-operations continue to rely on such rudimentary exploration methods, new techniques are gradually finding their way into the sector. For instance, Mabhena (2012) describes how the introduction of metal detectors greatly increased the efficiency and profitability of ASGM in Zimbabwe. A more extreme example is Verbrugge's (2014) description of assay laboratories in the Southern Philippines, where ASGM-operators can have their samples analyzed by professional chemists. During an international conference on artisanal and small-scale mining in Livingstone (Zambia), which was attended by miners from across the globe, one of the authors (Boris Verbrugge) witnessed demonstrations of gold detectors and mobile assay laboratories.

In industrial gold mining, exploration methods have dramatically improved in the last couple of decades, from a mere reliance on (near-)surface observations, to the use of sophisticated technologies that enable the detection of hidden mineralization at ever-increasing depths (Randolph 2011). Of particular importance were developments in geophysical exploration methods, the increased availability of satellite imagery, and advances in digital technology, all of which enable faster and on-site processing of geological data.

In both ASGM and industrial gold mining, technological innovations were enabled and have spread as a result of increased investment. The global gold mining boom discussed in Chapter 3 went hand in hand with a rapid growth in exploration budgets, which increased from approximately USD 1 billion in 2000, to nearly USD 6 billion in 2012 (World Gold Council 2018a). During the boom years, exploration activities have increasingly moved into newer and more risky gold mining destinations in sub-Saharan Africa (see Luning, this volume) and Latin America (Dougherty 2016). After 2012, exploration budgets decreased considerably, to approximately USD 2 billion in 2016 (World Gold Council 2018a), before rising again to nearly USD 5 billion in 2018 (S&P Global 2019). Today, while more established gold mining destinations like Canada, Australia, and the United States continue to attract the

Table 5.1 Exploration spending by country, in % of total spending

Canada	17	Burkina Faso	3
Australia	16	Colombia	3
United States	9	Brazil	3
Mexico	6	Argentina	2
Peru	4	Mali	2
Chile	4	Côte d'Ivoire	2
China	4	Tanzania	2
Russia	3		

Source World Gold Council (2018a)

bulk of exploration spending, substantial amounts of exploration spending continue to flow to newer and riskier gold mining destinations like Peru, Burkina Faso, and Mali (see Table 5.1).

5.1.2 *Junior Mining Companies*

In the mining industry as a whole, exploration tends to be undertaken by four types of companies (Randolph 2011). A first type is domestic public and parastatal companies that can bank on their intimate relations with host governments and local politicians. A second type is major multinational companies that decide to conduct exploration activities themselves. A third type is state-owned mining companies that attempt to acquire mineral resources abroad, often with the help of national governments. Several of the big Chinese mining companies fit within this third category. A fourth and final types are smaller and less-capitalized junior mining firms that specialize in high-risk exploration activities, in the hopes of attracting the attention of major mining firms and investors.

Gold exploration is primarily conducted by junior mining firms, most of which are based in Canada (and to a lesser extent also in Australia), where they raise capital on the Toronto-based TMX Group of securities exchanges (Majury 2014). So why is it that junior companies have come to play such a prominent role in gold exploration? As indicated earlier, part of the explanation lies in the material properties of gold, whose high value and diffuse occurrence make it accessible to smaller and less-capitalized players (Dougherty 2013). Meanwhile major mining companies have been more than willing to leave high-risk exploration activities to junior miners. More so than gold mining, exploration is a highly speculative affair, which relies on the ability of junior companies to raise venture capital (Majury 2014). In addition to the obvious geological risks, there often exists uncertainty legal and physical access to promising gold deposits. In many new gold mining destinations, the process of negotiating access to gold deposits requires a "hands-on" approach that may involve messy negotiations and shady deals with local powerbrokers (Dougherty 2015). Due to their lower public visibility, junior miners are better equipped to engage in this sort of behavior. The messy character of exploration is also reflected in the fact that it often involves different companies: Initial exploration activities are often conducted by very small companies, which are then taken over by somewhat larger (but still relatively small) companies in the late exploration and—permitting stage (Dougherty 2016). Throughout this process, it is not unusual for companies to change names or to merge with other companies, all of which adds to a pervasive sense of confusion on the ground. This situation also makes it difficult for researchers to come to terms with the situation on the ground. Ultimately, the overwhelming majority (roughly 95%) of exploration activities never develop into full-blown mining activities.

5.1.3 Linking Exploration to ASGM

For obvious reasons, exploration often takes place in the vicinity of ASGM-operations. In their presentations to potential investors, ASGM-operators have been described by junior mining companies as "barefoot geologists" (Mwaipopo et al. 2004: 26) or as "an index for promising patches" (Luning 2014: 72). At the same time, they often treat them as "disposable illegals" (ibid.) that can be evicted when so desired. As Luning (this volume) demonstrates in her chapter on Burkina Faso, while the balance of power may be tilted in favor of junior mining companies that wield a formal mining license, complex interactions can unfold between them. More precisely, junior mining companies are often pragmatic in their dealings with ASGM, because they realize all too well that attempting to ban it altogether may not only be unnecessary, but might even prove counterproductive and may jeopardize their "social license to operate." Instead, they opt to prevent the entry of ASGM into the most promising areas of their concession, while tolerating it in other parts. In many cases, things change once mines move into the "mining" stage (see below). Aside from these everyday interactions between junior miners and ASGM, Luning also draws attention to the transmission of geological and mining knowledge between both parties. In several interviews conducted by Boris Verbrugge in the southern Philippines, it was suggested by ASGM-financiers that staff of junior mining companies that were exploring in the area were "leaking" geological data in exchange for monthly contributions.[1]

5.2 Gold Mining

5.2.1 Technological Innovation

Broadly speaking, the extraction of gold-bearing material can occur through surface mining or through underground mining. Surface mining involves the removal of all material, including overburden, and often takes the form of open-pit mining. Underground mining leaves the overburden in place and instead targets higher-grade deposits through networks of shafts and tunnels. The decision to rely on surface—or underground mining techniques—may depend on a number of factors, including the geological characteristics of ore bodies, political and social conditions in surrounding areas (e.g., densely populated areas are less conducive to open-pit mining), and the availability of a skilled workforce (underground mining tends to be more labor-intensive) (Nelson 2011). Overall, surface mining is usually preferred over underground mining, because development costs tend to be lower, start-up times are quicker, and working conditions are safer. At the same time, however, due to its sheer scale, it is often more environmentally destructive and can have a profound (and lasting) impact on local livelihoods systems (Bury 2004).

Since the 1970s, the mining industry as a whole has witnessed a shift from more labor-intensive underground mining to more capital-intensive, "low-grade, super-large, high-tonnage, and ultra-mechanized" open-pit mining (Darling 2011: 4). In the gold mining industry, open-pit mining now accounts for approximately three-quarters of global mine production (World Gold Council 2018a: 31). Two factors in particular have contributed to this shift. One is the declining importance of South African mining, which has historically relied on massive, labor-intensive underground mining operations. A second factor is technological innovations. In addition to the growing availability of bigger and more modern mining equipment, the diffusion of more efficient processing techniques (prime among which is cyanidation, which is discussed in more detail below) has greatly increased value-to-volume ratios, thus enabling the profitable extraction of lower-grade deposits (Dougherty 2016). In this way, technological innovations can respond to the challenges of scarcity and costs, which were discussed in Chapter 3.

However, there are important indications that the trend toward ever-bigger open-pit mining operations may be set to reverse. As social opposition continues to rise, the regulatory environment in many countries is becoming increasingly prohibitive (World Gold Council 2018a). Moreover, many open-pit mining projects have reached their geological limits. Meanwhile automation is reducing the need for skilled mining labor in underground mines (Albanese and McGagh in Darling 2011). While it is too soon to fully understand its impact, there are clear signs of an impending digital revolution, epitomized by the emergence of "digital" mines that rely on far-reaching automation and "big data" (PWC 2017). At the 2019 Mining Indaba forum, for instance, Australian Resolute Mining presented "the first fully automated underground mine" in Syama, Mali.[2]

In the case of ASGM, the different chapters in the second part of this book clearly showcase the tremendous diversity of ASGM, which has become a catch-all term for a wide variety of gold mining activities with varying degrees of capital—and labor intensity. Broadly speaking, a similar distinction can be made between surface mining (e.g., the Brazilian garimpos and Colombian mines that rely on the use of excavators) and underground mining (e.g., the shallow-pit mines in Ghana, or the complex underground mines in the Philippines).

5.2.2 *Consolidation*

The "commodities super cycle" that started in the early 2000s represented the starting point of a process of consolidation in the global mining industry. This process of consolidation led to the decreasing importance of "mid-tier" mining companies that focus on one or a few minerals, and typically operate a few mines in one world region. Instead, we have seen a concentration of power in the hands of major "diversified" miners, such as Glencore and Rio Tinto, which target a broader range of minerals, and build on economies of scale to operate a high number of mines across the globe (Humphreys 2015).

While gold was technically not part of the commodities super-cycle, rising gold prices from the mid-2000s onwards have similarly spurred a process of consolidation. As of 2017, the ten largest gold mining companies were responsible for approximately thirty percent of global mine production (Els 2018). By early 2019, a new wave of mergers and acquisitions was underway, prime among which were Newmont's acquisition of Goldcorp, and the merger of Barrick Gold and Randgold into new industry leader Barrick. As can be gleaned from Table 5.2, despite the global expansion of gold mining and the emergence of China as a gold mining giant (see Chapter 3), and with the notable exception of Uzbek state-owned company Navoi MMC, the world's leading gold mining companies are still headquartered in the historical "gold mining core." Moreover, despite a clear trend toward consolidation, compared to other segments of the mining industry the gold mining industry still retains a fairly large number of small- to mid-tier producers (Ericsson 2012). In some cases, this includes junior mining companies that start extracting gold themselves, with or without the required licenses (Dougherty 2013). Finally, the outsourcing and subcontracting trends described in Chapter 4 have transformed some of the major gold mining companies into "loose networks" of suppliers and contractors. While the "lead firm" increasingly concentrates on a very limited number of "core tasks" such as financing, specialized suppliers may take over nearly all other tasks in gold mining and processing. As was explained in Chapter 4, big data are rapidly boosting the need to accumulate and "sell" specialized knowledge.

Table 5.2 Top-10 gold mining companies by production volume (in tons), 2017

Company name	*2017 production (tons)*	*Country HQ*
Barrick Gold	165,6	Canada
Newmont	163,8	United States
AngloGold Ashanti	116,8	South Africa
Kinross Gold	81	Canada
Goldcorp	79,9	Canada
Navoi MMC	77	Uzbekistan
Newcrest Mining	71,1	Australia
PJSC Polyus	67,2	Russia
Gold Fields	62,6	South Africa
Agnico Eagle	53,3	Canada

Source Thomson Reuters (2018)

5.2.3 Linking Industrial Mining to ASGM

One of the basic premises of this book is that rather than constituting two distinct "sectors" or "spheres," ASGM and industrial gold mining are integrated into one overarching global gold production system. While the academic literature and media reports continue to focus on instances of conflict between ASGM and industrial mining (see, e.g., Carstens and Hilson 2009; Patel et al. 2016), and while there is no doubt that the likelihood of conflict indeed increases when we move from the exploration—into the mining stage (see Luning, this volume)—we have already highlighted in Chapter 4 that complex linkages may develop between ASGM and industrial gold mining. While these linkages—which may range from informal relationships to full-blown production and marketing agreements—are applauded by international observers, they may also increase pressures on the workforce.

5.3 Processing

Once gold-bearing rocks are extracted, we move into the processing stage. Compared to gold mining, which inevitably needs to take place wherever gold deposits are located, gold processing need not take place on-site. Indeed, mining companies will often limit themselves to a minimal level of on-site processing in order to produce a more concentrated product, which can then be transported and refined elsewhere. They will typically crush and grind the gold-bearing rocks, reducing them to powder that is ready for the next phase of processing.

In industrial gold mining, cyanidation is by far the most widely used processing method. Cyanidation first appeared in South Africa in the 1880s, where it essentially rescued the country's nascent mining industry (Schoenberger 2014). By that time, higher-grade near-surface ores had been mined out, and the deeper and more fine-grained gold was too difficult and costly to process. This changed with the advent of cyanidation, which resulted in a massive increase in annual gold production, from a mere 300,000 ounces in 1888 to over 3 million ounces one year later. Today, cyanidation takes the form of heap leaching or tank leaching (ibid.). Modern heap leaching methods were developed by the US Bureau of Mines and paved the way for a revival of the US gold mining industry. It involves crushed ores being sprayed with a cyanide solution that dissolves the gold, which is separated thereafter. In "tank" or "vat" leaching, the cyanidation process takes place inside large tanks. Tank leaching is usually more expensive, but is also more compact, faster, and more efficient (i.e., it has higher recovery rates). For these reasons, it is often applied to high-grade ores. Improvements in cyanidation processing have enabled the extraction of lower-grade deposits, have greatly increased value-to-volume ratios, and therewith the profitability of gold mining. The gold solution that remains once the ores have been processed is then transformed into a dried *cake* with the help of electricity, before this cake is melted into blocks of *doré*, an alloy of gold, silver, and possibly other metals (Mooiman et al. 2016; Bloomfield 2017).

In ASGM, gold-bearing rocks are usually crushed by hand or mechanically (often using ball mills) before the gold is extracted using simple gravitation methods (e.g., a sluice box) and/or mercury amalgamation. In the latter case, once mercury has been applied to capture gold particles, the mercury-gold amalgam is then torched to separate the gold and mercury—although the end product will still contain a mercury residue (Esdaile and Chalker 2018). Significantly, several chapters in the second part of the book (particularly those on Indonesia, the Philippines, and Guinée-Burkina) demonstrate that cyanidation is finding its way into ASGM. This shift toward cyanidation is not only dramatically expanding the scope of ASGM, but is also having profound consequences for systems of labor organization and revenue-sharing: In both the Philippines and in Burkina, the diffusion of cyanidation has contributed to processes of consolidation in the value chain and to more unequal systems of labor organization and revenue-sharing.

5.4 Refining

5.4.1 Technological Innovation and Differentiation

The *doré* bars that are produced by mining companies are subsequently sent (usually through air freight) to independent refineries across the globe. Most of the world's gold (around 90%) will at some point pass through the hands of one of the 69[3] refineries that are included in the Good Delivery List of the London Bullion Market Association (LBMA), the world's leading gold trading association. While LBMA-listed refineries now exist in a wide range of countries, since the Second World War the refining industry has been dominated by a small number of Swiss-based refineries, prime among which are Metalor, Argor-Heraeus, Valcambi, and

PAMP (Pieth 2019). Inclusion in the list provides refineries with privileged access to the London gold market. To be included, refineries have to meet with a wide set of requirements in relation to (among others) bar quality, output levels, and compliance with the LBMA's Responsible Gold Guidance, which intends to assure investors and consumers that all gold that is bought and sold by refiners is "conflict-free."[4] Like many other certification and monitoring systems in the (gold) mining industry, the Responsible Gold Guidance is based on the OECD due diligence guidance. To realize economies of scale, but also to avoid compliance issues, LBMA-listed refineries will cater primarily to industrial mines and to central banks. ASGM-gold will raise a "red flag," which requires refiners to undertake a range of additional steps to ensure that they have identified and addressed any risks in their supply chains.

To our knowledge, there exists no systematic research on changes in the global refining industry. Available evidence indicates a trend toward geographical diversification and rising competition, epitomized by the growing importance of refineries from China, India, and Dubai. While several of the bigger Chinese refineries are now included in the LBMA's list of good delivery, all but one Indian refinery (MMTC-PAMP, a subsidiary of Swiss PAMP) and all Dubai-based refineries operate outside the LBMA-system. Particularly noteworthy is Dubai-based Kaloti Precious Metals, which is building a refinery with a capacity that exceeds that of the Swiss refineries (Torchia 2014). In addition to these larger players, the world is dotted with a large number of smaller refineries. While some of these refineries are based in non-producer countries (e.g., Baird & Co in the UK, Tony Goetz in Belgium), there has been a notable increase in the number of refineries in new gold mining destinations like Colombia, Mali, and Uganda—a trend that, according to a well-placed observer, is facilitated by the increased accessibility of refining technology.[5] A notable example is a recent move by the Tanzanian government, which has granted two Chinese firms licenses to construct gold refineries that would cater to the country's blossoming ASGM-economy (Ng'Wanakilala 2019). However, none of these new refineries is anywhere near to complying with LBMA-requirements.

Growth in the number of refineries has resulted in excess refining capacity. Even established refineries are now forced to be more inventive to secure a steady supply of gold. According to an anonymous respondent with insider knowledge on the refining business, one of the ways in which they are dealing with this new reality is to get "boots on the ground," by setting up direct linkages with mines, refineries, and agents in new gold mining destinations.[6] Several of the LBMA-listed refineries are also undertaking efforts to integrate "legitimate" ASGM-activities more centrally in their supply chains[7] (Pieth 2019). Still, as noted above, the lion's share of ASGM does not meet conventional definitions of "legitimate" (read: legal) ASGM, and most refineries therefore openly refrain from sourcing from ASGM. This effectively excludes ASGM-operators from easy, direct access to global gold markets.

Once gold is refined, it will likely pass through the hands of large bullion banks, who act as vital links between miners, refineries, and global gold markets. These bullion banks then sell the gold to central banks, investors, and jewelers across the globe (Bloomfield 2017). While most of the trade in physical gold continues to take place on the London Bullion over-the-counter (OTC) market, between members of the LBMA (Ferry 2016), London's relative importance as a gold trading hub is quickly diminishing. In addition to the growing importance of the US Futures Market (particularly the COMEX Derivatives Exchange), the rise of China as a major gold producer and consumer has gone hand in hand with the growing importance of the Shanghai Gold Exchange (which is now the largest purely physical spot exchange in the world) and the Shanghai Futures Market.[8]

5.4.2 *Linking ASGM to Gold Refineries*

Based on our description so far, we seem to have witnessed the emergence of a dual refining industry. On the one hand, we find a small group of LBMA-listed companies that cater primarily to industrial gold mines and central banks and have privileged access to the London gold market. On the other hand, we find a growing number of small- and medium-sized refineries that operate outside the LBMA-system, and cater to a more heterogeneous clientele, ranging from private individuals and jewelers to smaller mining operations.

As is the case in gold mining (see Chapter 1 of this book), this image of a "dual refining industry" is misleading. As LBMA-listed refineries are increasingly looking for alternative suppliers, their supply chains are becoming exceedingly complex. In addition to working with intermediaries in new gold mining destinations, many LBMA-listed refineries are now sourcing gold from smaller refineries, who would otherwise remain excluded from access to the London gold market. All of this greatly increases the probability that ASGM-gold—wittingly or unwittingly—enters the supply chains of LBMA-listed refineries. Numerous reports have confirmed the existence of intricate connections between ASGM-producers and gold refineries in Dubai and Switzerland (for an overview see Pieth 2019). In some cases, ASGM-gold is refined and sold in domestic markets. In many other cases, it is exported to refineries in other countries and subsequently finds its way into global gold markets.

As Cortes-McPherson demonstrates in her chapter on Peru (this volume), standing between ASGM-operations and refineries (in this case in the United States) is a wide range of intermediaries, which variably include local gold buyers, larger buyers (so-called collectors), local refineries, and gold smugglers-cum-exporters. In addition, she draws attention to the role of commercial flights in facilitating the "illegal" trade in ASGM-gold. It is important to note that the trade in ASGM-gold is facilitated by the material properties of gold as a small and valuable product that can easily be processed into tradable metal form, but can also be smuggled across borders with relative ease. Gold from different sources (which may include newly mined gold and recycled gold) is often smelted together close to source. For all of these reasons, once it leaves the mine (or the recycler), the origins of gold become extremely difficult to ascertain (Young 2018).

5.5 Recycling

As we already noted in our introduction to Chapter 3, one-fourth to one-fifth of the global gold supply is contained in "above-ground supplies," which consist chiefly of recycled gold. The relative weight of recycled gold in the total gold supply fluctuates with the price of gold (the higher the price, the more gold is recycled) and broader economic conditions (in periods of economic crisis, people will often sell gold to raise cash) (World Gold Council 2018b). High-value gold recycling (mainly old jewelry) accounts for approximately ninety percent of all recycled gold. The remaining ten percent is accounted for by industrial recycling, which consists chiefly of waste electrical and electronic equipment (WEEE), or e-waste (Lepawsky 2015). High-value gold recycling is relatively straightforward, and much of it takes place on a small scale close to source, often by jewelers themselves. Industrial recycling, in contrast, requires large sites with technologically advanced equipment. For this reason, industrial recyclers often consolidate their operations in one or a small number of locations (e.g., the Umicore plant in Hoboken near Antwerp, Belgium), from where they serve the global market (World Gold Council 2018b).

While gold recycling will not be discussed further in this volume, it is worthwhile noting that interesting parallels can be drawn between the situation in gold mining and in gold recycling. More precisely, despite the complexity of industrial recycling, substantial amounts of e-waste are being recycled in informal conditions, particularly (but not exclusively) in developing countries. Zooming in on informal e-waste recycling in India, Laha (2014) convincingly demonstrates that informal recycling is "functionally interconnected with the formal waste management system and its international production network" through a range of middlemen, dealers, recycling companies, and exporters.

5.6 Mapping Global Gold Production

In Fig. 5.1, we bring together the different stages in global gold production, the actors involved in them, and the more or less distinct (as illustrated by the dashed and solid lines) relations that connect them. The boundaries between formal and informal are blurred, with various linkages and intermediaries connecting ASGM to exploration activities, industrial mining operations, refineries, and global gold trading circuits. It is important to note that while the distinction into different production stages has clearly been instrumental in organizing our analysis, it should not disguise the fact that actors may be involved in different production stages. Examples include junior mining companies that (also) become engaged in mining and processing gold, gold traders and banks that finance gold mining activities, or refineries that become involved in gold trading.

5.7 Conclusion

In this closing chapter of part one, we have zoomed in on technological innovation and change in gold production. Compared to several other segments of the mining industry, where power is concentrated in the hands of a small number of major multinational companies, the gold industry is less concentrated and is open to smaller and less-capitalized players. This is illustrated not only by the large number of junior mining companies (Dougherty 2013), but also by the growing number of small

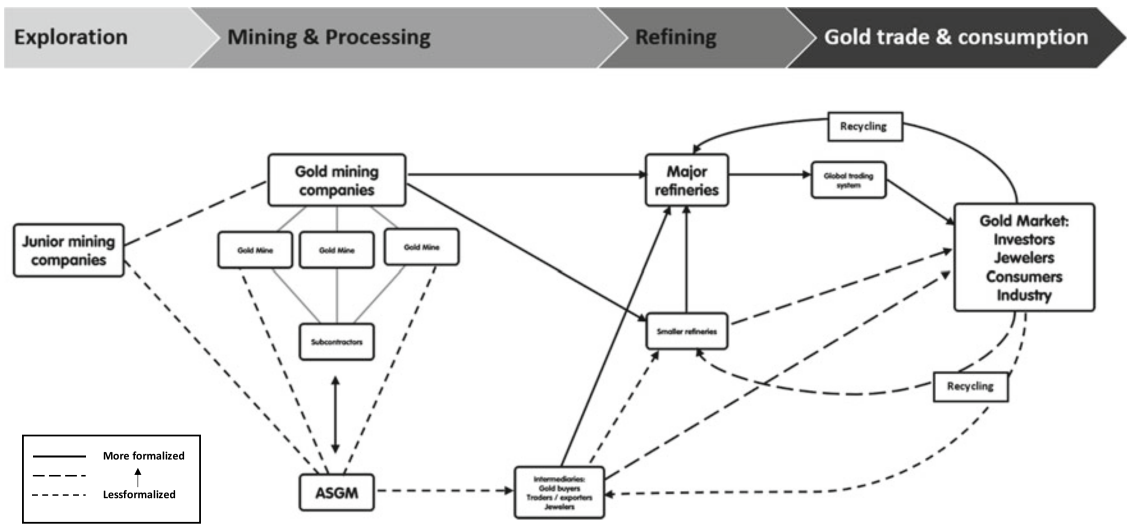

Fig. 5.1 Mapping global gold production

refineries that operate outside the LBMA-system, and by the staggering number of ASGM-activities that operate across the globe. This "democratic" character of gold mining is at least partly related to the material properties of gold, as its high value-to-volume ratio and the relative ease of extraction and processing significantly reduce entry barriers for smaller and newer players.

More broadly, technological innovation can be treated as a third response (in addition to global expansion and informalization) of the global gold production system to the systemic challenges that were identified in Chapter 3 (scarcity, resistance, and costs). More precisely, it not only enables the profitable extraction of more complex and more diffuse deposits (thereby temporarily addressing the problem of scarcity), but it can also contribute to addressing the problems of rising costs (e.g., digitalization replacing labor) and even increased resistance (e.g., technologically advanced underground mines replacing controversial open-pit mines).

Notes

1. These interviews were conducted in January 2014 with the local staff of two junior mining companies (Batoto Resources Corporation and Agusan Metals Corporation) in the municipality of New Bataan, on the southern island of Mindanao.
2. Observations done during the 2019 Mining Indaba conference in Capetown, February 2019.
3. As of 12 September 2018. An up-to-date list can be consulted on the Web site of the LBMA, see http://www.lbma.org.uk/good-delivery-list.
4. The current good delivery rules can be accessed at http://www.lbma.org.uk/assets/market/gdl/GD_Rules_16_January_20190131.pdf. The Responsible Gold Guidance—like many other certification and monitoring systems in the mining industry—is based on the OECD due diligence guidance.
5. Interview with anonymous respondent.
6. Ibid.
7. Legitimate is defined in the OECD-guidelines as, among others, ASM that is consistent with applicable laws—although the guidelines leave room for the inclusion of ASM-operators that undertake "good faith efforts" to operate within the applicable legal framework (where it exists). In either case, it excludes ASM that contributes to conflict or other human rights abuses.

8. More information about the (changing) structure of the global gold market can be found on the Web site of the World Gold Council, see https://www.gold.org/what-we-do/gold-market-structure.

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