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REPORT

# ASGM Investor Introductory Course

Instructor's Guidebook

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## About the Author

The Artisanal Gold Council (AGC) is a charitable non-profit NGO dedicated to improving the opportunities, environment, and health of millions of people involved in artisanal and small-scale gold mining (ASGM) in the developing world. Based in Canada, AGC has worked in over 30 countries and with hundreds of artisanal and small-scale mining communities around the world on topics including but not limited to: community development, poverty reduction, formalization, mining policy, markets and supply chains, public health, environmental management, mining engineering, and human rights.

AGC operates from the principle that improving the global ASGM sector requires direct intervention at the community level. The AGC therefore has a long history of working with mining communities. Lessons learned, and knowledge gained from working with ASGM communities around the world, are embedded in the design of all AGC's teaching and learning materials.

Find out more at: [www.artisanalgold.org](http://www.artisanalgold.org)



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## Purpose

This curriculum is intended to introduce the ASGM sector to potential financiers and investors. These teaching and learning materials are designed to be “open source,” meaning that they are made available freely for use by programs, organizations and institutions of all kinds working in the artisanal and small-scale gold mining sector. These materials are meant to be used as basic materials that can be modified and adapted to suit the investor audience. We hope that other organizations will use this curriculum to help finance a more responsible, formal, and ultimately more professional ASGM sector worldwide.

## Background on the ASGM Sector

Artisanal and small-scale gold mining (ASGM) is a predominantly livelihoods-based mining activity practiced in over 80 countries around the world. ASGM is often distinguished from large and medium-scale gold mining by its low levels of mechanization, high levels of labor input and higher ore gold grades. As of 2018, it is estimated that ASGM practitioners world-wide produce between 400-600 T of gold annually, representing approximately 20% of the world's annual gold production.

ASGM is increasingly recognized as a significant driver of rural development in lesser industrialized countries as well as an important sector for poverty alleviation. ASGM miners often capture upwards of 85% of the international price of gold, making ASGM an excellent mechanism for the transfer of wealth from richer urban centers to poorer rural communities. Due to its largely informal nature, ASGM has been associated with poor environmental and social practices. Notable amongst these is the practice of using mercury to amalgamate gold and separate it from its ore. ASGM is currently the largest anthropogenic source of mercury emissions and releases world-wide.

Efforts to improve the ability of ASGM to deliver transformative benefits to rural communities while eliminating some of its worst practices require a meaningful engagement with the sector by governments, civil society, the private sector and the public at large. Helping build the capacity of the sector to operate according to higher environmental, social and business standards requires not only political and financial incentives, but also support and training for ASGM operators.

### ASGM Sector Participants

ASGM can be practiced by individual miners panning for gold in alluvial sediments (placer deposits) or can involve enterprises employing hundreds of specialized laborers who are sometimes organized into associations or cooperatives. Being an ASGM “practitioner” could therefore refer to a wide-ranging set specialized jobs including diggers, crushers, haulers, processing machine operators, managers and owners. Furthermore, ASGM is responsible for creating many spin-off service industries such as equipment suppliers, food services and transportation.

Finally, many consider downstream members of the gold supply chain, such as gold buyers and traders to be “practitioners” of ASGM. Men and women are both involved in ASGM supply chains in nearly every country it is practiced in. Some are economic migrants seeking better livelihoods, while others are residents exploiting a resource found in their “backyard” or traditional territory.

## **Need for Investor Training**

ASGM is a largely informal entrepreneurial activity that has become vital to the economic structure and fabric of many countries. In most cases, this has happened spontaneously without formal business development assistance offered by governments, financial institutions and vocational centers. Many artisanal and small-scale gold miners are eager to establish successful enterprises that contribute to their family and community's wellbeing. Unfortunately, the ASGM sector is often considered uninvestible for formal financiers/lenders. There are several reasons for this: size, complexity, legal status, geological uncertainty to name a few. This training package is designed to provide useful context for investors on the ASGM sector and to provide background information that allows potential investors to de-risk small-scale gold mining investment.

Many miners are eager to adopt better environmental and social practices including the conversion of mercury-intensive gold processing techniques to mercury free equipment and practices. Often there is a sound business case for making these transitions; however, doing so requires capital and investment.

If ASGM is going to transition away from being a predominantly informal activity linked to social and environmental problems, and towards a formal, professional and respected livelihood activity, the participation of the traditional financial sector will be required.

## **Course Materials**

Teachers should be prepared to bring certain classroom materials with them for the class to use. This may include:

- ▶ Notepads for group discussions
- ▶ Big flipchart paper
- ▶ Markers for the instructor(s)
- ▶ Personal teaching notes
- ▶ Course attendance sheets



## **Intended Learning Outcomes**

This is an introductory level training course on the artisanal mining sector. By the end of the training course, participants should have a basic understanding:

1. Understand the basic ASGM sector
2. Understand basic ASGM business models
3. Understand how to assess ASGM projects
4. Understand geological settings for gold mines
5. Understand some of the tools and techniques used to find gold deposits
6. Understand the basics of mine development and ore processing

# Course Introduction

## Slide 2

This seminar was produced by the Artisanal Gold Council, on behalf of the planetGOLD program, an initiative funded by the Global Environment Facility, with the aim of making small scale gold mining, safer, cleaner, and more profitable. The artisanal gold mining sector produces about 20% of the world's gold right now. So, it's a huge player in the international gold world. What we would like to see is it to take its rightful place as a full participant the formal gold mining sector.

## Slide 3

This is the planetGOLD footprint right now. The gold countries that you see there are phase one and the blue are phase two, which are called gold plus for a total of 23 countries. It's a great opportunity because it's a platform of communication between all these different countries.

## Slide 4

This is the five pillars that we concentrate on. The finance and investment box are the focus of this presentation. planetGOLD is working on all these elements but critically the sector needs investment and capital to improve. The purpose of the course is to familiarize you with the sector so that you can better understand the finance needs and opportunities.



# ASGM Introduction

## Slide 5

ASGM is generally focused on rudimentary ways of extracting gold that are often semi-mechanized. So, as an historical example, Canada really was an artisanal and small-scale gold mining country about 150 years ago and it really did form the backbone of the country. The Toronto stock exchange was born out of gold rushes in around 1900. It was part of the impetus to build railroads and other infrastructure for efficient mineral and resource exploitation. At that time in Canada, minerals were being exploited in a way that's very similar to the small-scale mining sector.

## Slide 6 and 7

ASGM background information outlining scale and the importance of investment [read information from the slides].

## Slide 8

Short course agenda.

## Slide 9

Introduction for geological fundamentals section.

## Slide 10

Context on rarity of gold deposits globally. [read text from slide]

## Slide 11

There is strong gold geological potential at plate boundaries or at areas that were located at plate boundaries in the past (Guyana, Brazil, Suriname, etc.).

So as geologists is we need to understand, the geological history. That's fundamental part of the story about understanding where to look for gold, but even once we identify a rich area, we still need to look in detail at geological processes in on our quest to understand how much gold is in the ground to be exploited and at what scale. Geologists are good at doing this. Sometimes it's an inexact science, but it's very important to look at the geological story.

## Slides 12 through 14

The west coast of the Americas is good example for plate tectonics. There's a subduction zone, classic geology or geological setting where the oceanic lithosphere gets heavy as it pools, and it sinks underneath the continental lithosphere.

And when it does that, all the water gets cooked out of it. That water causes melting and causes all kinds of volcanism which produces very hot fluids that can strip gold out of the surrounding country rocks that then concentrate as a hydrothermal or a vein deposit.

Colombia is a good place to tell this story because it's one of the rare places in the world where you have a spreading ridge in the middle of the Atlantic Ocean, and there's a little spreading ridge off the Pacific coast of Colombia that's actually being subducted. That is, there's a piece of the ridge getting subducted underneath Colombia. It's so full of water and it's so young that it causes some extreme types of formations to occur that haven't occurred on earth for a billion years.

Geologists really know how to look at earth history and explain why we find gold in these different environments. And then that helps us direct our efforts and concentrate on the correct geological areas to look for more.

### **Slide 15**

This is planetGOLD Philippines project, which is being executed by AGC, but it could also be in Indonesia because there's a lot exchange of people between Indonesia and the Philippines (they're right beside each other). In fact, the Filipinos are on the forefront of artisanal mining technology. They bring and distribute artisanal or small-scale mining technology that is cheap and rudimentary, but extremely effective. They manufacture and transport mining technology to the surrounding countries. You often meet Filipinos that are the chief engineers of small-scale mining or mining operations in surrounding countries. Historically, this is also true of Brazil as well, where the Brazilians will have been kind of acting like the Filipinos in the surrounding countries (such as Guyana).

### **Slide 16**

In some of those geological environments, you'll have vein deposits and veins don't usually occur as single deposits. They occur in sets and are often fault controlled. Some of the veins will be very rich in gold and some of them will be thick and other veins may be poor and gold, and there's usually sort of a sequence or a history of vein in placement.

The way the large-scale gold mining world works now is they would mine all the veins at the same

time. Often through an open pit approach if the system is close to surface and in other cases underground. However, by using a bulk tonnage approach, they get low grade, high tonnage deposits. So, they might be mining something that's five grams per ton on average (or lower) but some of the individual veins would be very rich (20, 30, 40 grams per ton), but they would be diluted by the country rock and by all the other material that gets milled. It's still a beneficial approach because they have a large tonnage, but low grade. This is almost never the case for small scale mining or for artisanal mining.

ASGM almost exclusively focuses on the high-grade portion of deposits due to the labour intensive nature of their operations and generally poor recovery from processing which is often mercury based. The economic opportunity is often centered on improved recovery with small investments in processing equipment. Further, often these types of interventions have significant social benefits due to the reduction/elimination of mercury consumption in gold processing.

### **Slide 17**

This picture shows a bunch of adapted grain mills. So, those machines that you're seeing, aren't designed for rocks at all, they're designed for milling taro and other grains to prepare food. The miners have used these small milling systems that are quite inefficient, but nonetheless, they're cheap and available, and they've used them to mill very high-grade vein material. The limitation is that they can only mine and process extremely high-grade veins with a cut-off grade somewhere around 15 grams per ton and they recover only ~30% of the gold with these techniques.

Importantly, when you think about the large-scale sector versus the small-scale sector, if you're only high grading - you're not producing much waste rock and doing very little (if any) stripping of waste. Further, the volume of tailings is very low, whereas, in large-scale mining, it can be quite high.

They also use very little energy to produce this gold therefore, carbon dioxide emissions are very low per gram of gold produced versus the large-scale mining sector.

### **Slide 18**

This picture shows the origin of placer deposits, which will have been created through the erosion of lode gold deposits or so-called vein deposits. You're also going to get some colluvium deposits and some lateritic deposits where the vein material has been heavily weathered, but most of the gold is still in place.

# ASGM Basic Field Geological Investigation

## Slide 21

Adequately defining the resource is usually one of the biggest hurdles faced by artisanal miners. They need to demonstrate that there is enough of a gold resource to pay back the potential investor with a reasonable degree of confidence. This step is critical to any mining project and is the first step in LSM as well. [read rest of the material from the slide]

## Slide 22

What techniques are available to artisanal miners? The major one is panning streams and tracing the gold upstream to find the source. Miners can also crush and hand pan hard rock samples to evaluate underground potential.

Hand panning and geological mapping can be very effective for exploration and understanding the geological system and is one of the main techniques that the ASGM miners will use. However, mapping properly requires specialized training.

Another excellent source of exploration information is the public domain. Junior miners or LSM miners that are in the region often report on their exploration activities to their shareholders through press releases/reports and access is free. Often the LSM exploration programs will cover areas where ASGM workings are, and the artisanal miners can use those as sources to focus their exploration or to direct their active mining in some cases.

The government often compiles geological data and performs geophysical surveys for regions to encourage investment which is easy to find from public sources.

## Slide 23

There are some inexpensive drilling methods as well. Auger rigs in laterite or saprolite will work well, hollow stem or solid stem depending on conditions. These techniques would be available to more organized artisanal mining communities. Backpack drilling rigs are more suitable in other cases, these drills can sample into hard rock. These rigs are very useful in cases where you have a good outcrop. The limitation there is that they can't go as deep, but often you can get, say a hundred feet or so. If the minors are attempting to trace a surface feature underground, backpack rigs can be very helpful. Other techniques include diamond drilling, but this method costs in the hundreds of dollars per meter and is usually beyond the reach of typical ASGM co-operatives.

## Slide 24

Industrial drones can currently be purchased for less than \$10,000 and you can often find good units used. These units can run gravity, magnetics, and LIDAR surfaces on very close line spacing with extremely high locational accuracy. These surveys are usually used to trace larger scale fault systems underground as well as the major rock units. This information can be used to better target other exploration efforts such as drilling and/or mapping.

LIDAR is a laser-based system that directs lasers at extremely high frequency towards the ground and the reflections that come back are used to map the topography below vegetation cover revealing ground features (such as faults, ridges of harder rock etc.). Mapping using LIDAR is often at a sub-centimeter scale. This can be helpful in artisanal mining to align mine workings on a map and for understanding what area has been mined and what hasn't been mined. It is often worthwhile returning to unworked areas in ASGM.

# ASGM Mine Development and Operation

## Slide 27

To develop the ASGM sector, the idea is to progress basically from left to right. To progress from an operation that's very simple into something that's more mechanized and more efficient with a higher gold yield.

## Slide 28

Here are photographs of different types of ASGM operations. In this case, the miner is a visually following a high-grade vein. This is an example of a very labor intensive, underground operation with some very basic very basic support timber support. This is a fairly typical underground operation in ASGM.

## Slide 29

In hard rock mining a minimum grade of 10 grams per ton is required to make it worthwhile going underground. Often you have the lower grade material where the veins will flare out and so on and you'll get into pockets of very high grade. Without geological understanding and exploration, mining under these conditions can be difficult where the ore is extremely variable. These are situations where project geological exploration is critical and can be the definitive factor in determining investment success. Good geological information allows operators to direct mining to areas containing high grade gold and to reduce the amount of waste in the ore which in turn reduces cost and improves profitability. Small investments in exploration can have a dramatic impact on project success.

## Slide 30

This is an example of a placer operation which are generally much lower grade. These deposits are often less than half or a quarter of a gram of gold per ton. Understanding the geology is important in these contexts to be able to forecast where the ore is likely to be.

Small investments in equipment can greatly increase gold yield in these operations. The drawback with these types of mines is that they can be very intensive from a land use perspective and if done improperly can be extremely environmentally destructive.

Systematic geological evaluation can be relatively inexpensive and significantly de-risks the project resulting in higher investor confidence.

### **Slide 31**

When evaluating projects, it is important to confirm that the processing plant is close to extraction operations to reduce transportation costs. In an open pit operation, fuel is usually the largest cost input. Designing the infrastructure efficiently is very important and it can affect profitability dramatically.

### **Slide 32**

This is an example of processing system with a small ball mill. These mills are easy to find used and you find several different types and different scales of mills in the pre-owned market. So, it can be quite inexpensive to set something like this up. The trade-off with used equipment, is higher maintenance costs. Further, many of these mills are modular and can be pieced together to suit the mining conditions and scale. They can also be designed to expand through free cashflow. For example, if the deposit has a high-grade core, it can be exploited first and the resultant cashflow can be used to expand the operation. Often, this is the easiest and most reliable way to finance an operation.

# ASGM Project Economics and Valuation

## Slide 35

As previously mentioned, about 20% of the gold annual gold production is from ASGM. It's a very large industry that's underappreciated and roughly 90% of all gold miners work in ASGM with the remainder in LSM. This results in direct wealth creation for people that are participating in the industry. So it's a very important mechanism for people to improve their standard of living. [read material on slide]

Small investments in ASGM can unlock significant value and have significant multipliers through the community and the local environment.

## Slide 36

These are the main factors that a potential investor would assess when considering an ASGM project. They largely mirror the key considerations for LSM projects. Gathering, organizing and presenting this information is critical for ASGM projects that are looking for investment. In LSM, this information forms the basis of a project specific technical report (the Nation Instrument 43-101 report, or NI43-101, in Canada). These reports cover all the background information that an investor would need to make an investment decision (i.e. water availability, access, topography, power, climate, geological setting, reserves/resources, local workforce training/education level, financing needs, expansion potential, tax, royalties, concession ownership, etc.).

## Slide 37

The technical report also forms the basis for a project financial model and provide the general inputs to a business plan that is a tool to attract investment. The business plan would cover the potential use of funds and would show how the investor's capital would be used to create project value and how that value would be distributed.

## Slide 38

This slide shows a little more detail on what would be covered in a technical report. It's based on the NI43-101, but in the case of ASGM, the report will not define a resource/reserve. ASGM projects generally will not have the education or financial tools required to outline a resource. Therefore, the focus of the report would be on historical gold production as well as project geological potential. Technical reports are always written by a qualified professional who is recognized as an expert on



the subject matter of the report.

These technical reports give a fundamental, succinct description of the project as well as recommendations for further work to create project value.

### **Slide 39**

Even in cases where there is only a very rough estimate of historical gold production, this information may give some insight into the future gold production potential of a project. Therefore, historical production is a key input into the technical report (both historical and current production). The report would provide details on that production (grade, recoveries, processing means, plant through-put, mining rate/method, etc.). Based on these facts, the Qualified Professional would make recommendations for capital improvements, outline the likely outcomes and provide values for the project (pre and post investment).

### **Slide 40**

Management is incredibly important in mining projects and is key consideration for investors. Investors look at manager competence and organizational systems as well as track records when making an investment decision. The project may have geological potential but if management is weak the project may not be investible. This slide lists some questions to consider regarding project management.

### **Slide 41**

Environmental issues are very important for society and the planet, and are considered seriously by modern investors. Ignoring environmental regulations may result in the loss of operating privileges. Proper permits and following regulations are critical to project development and operation and are therefore a key consideration for investors. Tailings management is often overlooked in this context but is critical to project viability. This slide lists several questions that should be posed regarding any mining operation before investment (go over questions)

### **Slide 42 and 43**

The local social license to operate makes and breaks projects. Improper consultation with local communities has resulted in many projects not going forward in LSM. Project benefits need to be equitably shared, and the local people must see the benefit. Local culture and indigenous rights must be properly considered. Pollution issues such as dust and the noise must be managed. In the end, the local standard of living must be sustained or improved. Again, these two slides list key

questions when evaluating social license to operate (go over questions)

#### **Slide 44**

Safety is a big de-risking issue for investment but is often not a priority in ASGM. However, improper safety practices pose a direct threat to health and well-being of workers as well as affect production levels, permitting and worker morale. This is therefore an important area to focus on for investors.

A common thread and safety issue through many ASGM sites is the use of mercury to recover gold. Prolonged mercury use leads to cognitive impairment, birth defects and even death.

Investment in processing significantly improves ASGM operational safety through the elimination of mercury amalgamation while improving gold recovery.

#### **Slide 45 and 46**

Historically, government policy around ASGM in many jurisdictions tried to limit development and discourages ASGM projects. In many countries, there aren't suitable tenure systems in place for ASGM or the regulations are onerous to the point where projects aren't viable. Sometimes the policies are well-meaning but make investment incredibly difficult.

For example, if an ASGM permit can only be held by a local citizen or it can't be held by a corporation the regulations can make foreign investment next to impossible and it can greatly limit the potential investor pool. These policies have to be well thought out and investors have to understand what these policies are to make sure that they're on side and comfortable with the risk profile.

Often, if regulations are overly restrictive, the government is basically ensuring that ASGM operations will be done informally and pseudo illegally. Policy really must be directed at the community and for the community in a realistic way.

However, these attitudes, laws and regulations are changing in many locations, and mining codes are being adjusted to be more suitable for ASGM. Investors should be aware where these reforms are active.

#### **Slide 47**

A path forward for ASGM projects to formalize is being created by organizations like the OECD by creating due diligence standards for the downstream market allowing these downstream players to purchase artisanal gold legally. However, to get there, ASGM organizations require financing to



have the capacity to produce gold responsibly without mercury.

It comes back to finance and access to capital – these are key for moving these projects forward in a formal environment. Improving their operations will increase their gold yield which will increase income to the community through the multiplier effect.

### **Slides 48 and 49**

These slides summarize many of the issues and barriers that we've covered such as ownership rights, permitting difficulties, and technical hurdles. Often the technical solutions aren't all that complex, which from an investment standpoint, can be a very lucrative opportunity. Even just a high-water table limits ASGM operations from accessing ore at depth. So, a small investment in pumping can have a huge impact on the project and provide an almost infinite return on investment calculated in the traditional sense. The same is true for underground mining techniques and blasting. Modern mercury free processing equipment can have the same scale of impact.

### **Slide 50 and 51**

Directed permitting and/or regulations that are designed for ASGM, that facilitate development rather than hindering it can have a massive impact on the country's ASGM industry.

NGOs can play a role in facilitating solutions as well through training, education and advocating on miner's behalf. NGOs can also provide technical services and provide equipment and training to reduce mercury amalgamation. For instance, concentrating through a gravimetric system can reduce the amount of mercury used at a given site by a factor of ten while improving the economics and recovery of the operation.

# ASGM Training Conclusions

## Slide 53 and 54

Investing in ASGM is a means of countries meeting their Sustainable Development Goals (SDGs). ASGM investment reduces poverty while improving health and education. It also reduces inequality through spurring economic growth and providing options for female participants in the sector.

Investments in ASGM projects can often be structured to benefit all parties and stakeholders involved (these deals are a WIN/WIN/WIN). The investor receives a good return on their investment, the ASGM operation improves its gold yield hence the project value and the environment in the vicinity of the mining operation is vastly improved through the reduction/elimination of mercury in the processing system.

## Closing Remarks

At this point the instructor should spend a few minutes summarizing each section of the course that was covered. The summaries do not need to be detailed and should not last more than a few minutes for each section. It is also important to thank attendees for their attention and participation during the course.

Following the summary, provide an opportunity for questions - this should ideally be run as an open forum.

## References

- ▶ Artisanal Gold Council (AGC) and Asia-Pacific Economic Cooperation (APEC), Koehler, B. and Rosenbluth, P., Small Business Management in the Artisanal and Small-Scale Gold Mining Sector – Teaching and Learning Materials Course Manual, 2019.



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