



Artisanal-small Scale Mining in Myanmar

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Abstract

In many parts of the world, artisanal or small-scale mining activities are at least as important as large-scale mining activities. The numbers of people employed are actually considerably greater than in large companies. In 2002, an estimated 13 million people a large percentage of those are women and children are artisanal and small scale miners operating mainly in developing countries. Although the numbers of small-scale miners and their dependents are estimated at up to 80-100 million people, governments are frequently reluctant to give legal recognition to artisanal miners [1].

This paper discusses approaches to develop the Artisanal-Small Scale Mining (ASM) sector in developing countries. This includes choice of mineral commodity, available technologies and economic/geological criteria. Other considerations include access to finance, area selection, and personnel. The parameters of mineral economic analysis are also essential for a successful ASM mining operation. Finally, choice of mining equipment is critical to success.

Keywords: Artisanal mining; Small-scale mining; Large-scale mining; Prospect; Deposit

Introduction

This paper is aimed primarily at readers who are not technically trained in the mining industry and at investors and small-mine operators. However, it may also be useful to other stakeholders related to the mineral industry. Most of the ideas presented are not new to the industry, but those unfamiliar with historic and current mining practice may find some of these ideas useful in addressing their problems. The author, as an exploration and mining geologist for over 40 years, has been associated with many small mine operators, and observed the wide range of problems and practices in operating mines and prospects. He has also contributed solutions essential to the success of small mine operations. Operators and prospectors are surprisingly

resourceful and innovative, and the author felt that their approaches should be made known to the wider mining community. The author's main concern is to end the exploitation of artisanal miners as 'free geologists' with no rights to their own discoveries.

Artisanal (ASM), small-scale mining and large-scale mining

These three categories are loosely defined, and may carry different definitions in different countries. However, the following provides a general differentiation among these types of operation:

Artisanal mining refers to mining by individuals, families or groups with minimal or no use of mechanization. The panning dish, pick and shovel are the main tools, with wooden boxes

used for sluicing. The capital investment required in such operation would be USD 100 or less.

Small-scale mining - possession of a legal mining title stating the name of the organization and its registration number is required. Such operations are typically semimechanized and do not require substantial investment and expenditure or specialized technical know how and methods.

Large-scale mining - modernized, mechanized, grade and reserves are established. Large-scale mining involves heavy capital investment in mechanization and other technologies.

Deposits are discovered but mines are made

Mines are made usually at great cost and not often with significant risk. The process of complex process that begins with a complete transforming a mineral deposit into a mine is an appraisal of the deposit.

The making of a mine demands detailed feasibility studies of many factors, any one of which, if shown to be negative, could prevent commercial exploitation of the deposit. Total feasibility analysis involves at least three major fields: (1) economic analysis, (2) financial analysis, and (3) political and environmental analysis [2].

Whilst prospecting is generally regarded as an individual contribution, undertaken by either a seasoned prospector or an experienced geologist, exploration requires a team of scientists. Moreover, prospecting is a discovery phase, while exploration is an evaluation phase - hence the Russian maxim: "We explore the prospects after it has been found." More clearly, "Deposits are discovered but mines are made."

Small is beautiful

Small mines will continue to be an important part of national economic systems, especially with increasing mineral prices. Many large mines grew from small mines, which in turn grew from prospects; hence, to ensure sufficiency of large mines in the future, we must develop our prospects and small mines of today. ASM is characterized as follows:

- High economic potential;
- Low-cost small-scale mining leads to an increasing reserve base for larger-scale operations;

- ASM can serve as a start-up for larger follow up operation;
- Discovery of giant deposits through ASM is statistically unlikely;
- Prospects should be economically mineable at present, not in 20 to 40 years;
- Processing technology allows better and better concentrations;
- Sustainability: local mining communities can benefit sustainably from ASM;
- Agriculture can go hand-in-hand with mining activities as part of the larger framework for rural development

When we are planning to invest in mining industry, we do not have much to choose from the present government mining operations. As such, to develop an economically successful mining operation, we should consider carefully. An overview of key factors and criteria for developing a mine is listed below.

Choose an economical mineral commodity

The following mineral commodities are found in Myanmar at commercial levels: a. Gemstones, b. Gold, c. Tin-tungsten, d. Antimony e. Base metals (lead, zinc, silver, copper).

Current average LME prices (London Market Exchange) of the above metals in 2013 May (Table 1) are as following:

If the mining method applied to the different mineral commodity is the same, the unit cost for mining will be approximately equal. Therefore, it is economically rational to choose a higher priced mineral commodity to maximize ROI. Thus, gemstones, gold, nickel, tin-tungsten and copper are more viable. However, the following additional factors must also be considered as selection criteria:

- a. Metal price trend
- b. Production trend/commodity supply
- c. Mineral commodity demand
- d. Future economic focus
- e. Geographic location

These are the fundamental criteria influencing selection of mineral for exploration. However, the following secondary factors must then be considered in evaluating feasibility of a deposit for economic exploitation (Figure 1).

1. Mineral economic situation
2. Technological situation
3. Geological situation
4. Geological features such as location, form, size, grade, etc.

Table 1 Current average LME prices of the common metals (May 21, 2013)

Metal	Price (USD)	Unit
Gold	973.055	troy oz
(Au)	31284.45	Kg
Nickel	14654.63	metric ton
Tin	13662.84	metric ton
Copper	5149.74	metric ton
Lead	1719.27	metric ton
Zinc	1655.11	metric ton
Silver	14.65390	troy oz
(Silver)	471.13	Kg
Aluminum	1664.83	oz

N.B = 1 troy ounce = 31.1034768 gm

Driving a car on a mountain road by looking in the rear mirror

In regard to developing a mineral discovery into a valuable mine, the first basic requirement is a viable market for the product. The second requirement is the capacity to deliver a quality salable product to that market for payment in an amount exceeding the cost of the operation.

Though simple, addressing these requirements may be far from easy, and there are no set answers or formula to address the question in any given situation the context of every mine is unique. Therefore, operating a mine based on past experience, economic forecasts and statistical "guesstimates" is just like "driving a car on a mountain road by looking at the rear mirror". You are the one who must select the items and ideas which can be applied to your particular operation. For readers unfamiliar with mining, the items presented are in logical order for the successful development of a mine.

Factors for consideration

Successful small mine development is sensitive to the following factors:

1. Price trends;
2. Potential future demand;
3. Either it can use simple mineral processing techniques (ore dressing) or not;
4. Security;
5. Access to infrastructure (roads, rail, ports, waterways, power, access to water);
6. Low production cost, quick production time, and safe working environment;
7. Flexible production capital investment;
8. Zoning: the proposed mine should not be located in proximity to areas designated for other uses such as agriculture, forestry or irrigation, or have other importance, e.g. archaeological or environmental;
9. Adaptability to new technology;
10. Political climate

Success in mining operation

In general, a mining function is concerned with the following elements:

- **Finance:** Adequate funding must be available for mining operation.
- **Area:** Some form of land tenure through concession, lease, option or claim is essential.
- **Staff:** Need well-qualified professionals.
- **Luck:** All successful operations involve an element of luck. However, in mining as in other fields of human endeavor, luck does not arrive on its own-it is generally the result of persistence and the rigorous application of proper methodology.

Parameters of mineral economic analysis

The two major elements of economic analysis are:

- Potential earnings or annual generated cash flow of the project.
- Investment costs necessary to realize such earnings.

If the difference between the two elements is large enough, i.e., if the return on investment from the cash flow is high enough to attract investors, the project can be said to be financially feasible [2].

The mineral economic analysis must take into consideration many parameters, some of which are known or knowable within certain limits, and others that are unknown or unpredictable within certain limits and for which estimates must be made. Because both known and estimated parameters enter into the same analytical computations, it

is important for the analyst to realize the nature of each when interpreting the results of an analysis, and especially the impact of such uncertainties on key risk factors. Some parameters such as the grade of mining block, although estimated, are said to be known within mathematically defined limits. Other parameters, such as the future price for minerals produced, etc., can only be estimated or "guestimated" within reasonable limits for which no precision can be assigned [2].

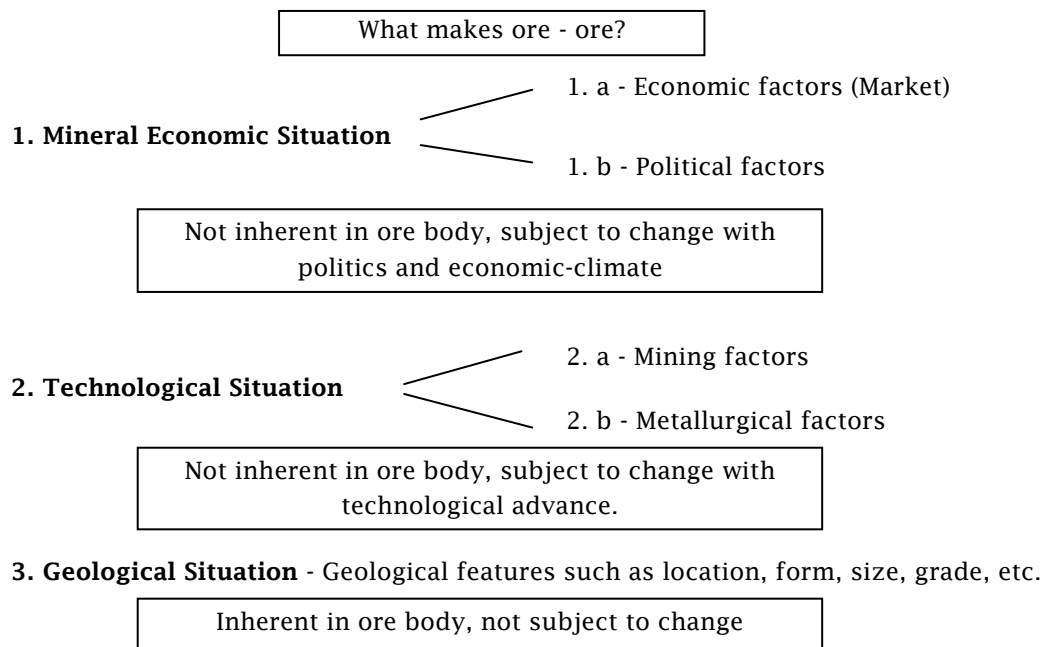


Figure 1 What Makes Ore-Ore?

Known or knowable mineral economic parameters

- Known or knowable parameters are:
- Tonnage and grade of valuable minerals for the total mineral body and for individual mining blocks.
 - Metallurgical recovery of valuable mineral.
 - Minimum operating life of mineral deposit at any specified production rate.
 - Royalty schedule, property payments, etc.
 - Sales-purchasing agreements-smelter schedules, marketing contracts, etc.
 - Tax structure (subject to change in the law), including governmental and local tax rates, depletion allowances, depreciation schedules, and investment credits and deferred deduction, etc.
 - Possible financing arrangements including equity or retained earnings and interest rate of debt financing, etc [2].

Estimated economic parameters

- These include the following (see also Figure 2):
- Total investment cost required, including depreciable items, expansible items, and others.
 - Operating costs including mining or extraction costs (ore and waste); milling, beneficiation, or processing costs; smelting and refining, finishing costs, transportation costs, remediation; and others.
 - Market prices for minerals produced.
 - It is obvious that some of the foregoing economic parameters can be estimated more accurately than others, or can be known with greater confidence (within a narrower range). Market price is often one of the most sensitive parameters in economic analysis, and yet is usually the most difficult to predict [2].

Mining equipment requirements

1. Flexibility
2. Mobility
3. Reliability
4. Robustness
5. Smartness
6. Compact, lightweight
7. Universal

Conclusion

Developing a major mineral project is not an easy task, but people have done it in the past, and some of you will do it in the future.

References

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CASH FLOW	
GROSS INCOME - Royalty (NSR)* - Operating costs	= grade × recovery × NS price × tons or pounds produced = royalty imposed on net smelter return or gross income = mining + processing + transportation, etc
GROSS PROFIT - Depreciation - Depletion - Deferred deduction, etc.	= sales, revenue - operating costs and royalty
TAXABLE INCOME - Income tax	= (national × tax rate) + (local × tax rate)
NET PROFIT + Depreciation + Depletion + Deferred deduction, etc.	
ANNUAL CASH FLOW	

Figure 2 Cash flow [2].