MERIT
A CESO AND WUSC PROGRAM

Mongolia:
Enhancing Resource Management through Institutional Transformation

Lifecycle of a Mine

Stage 1: Mineral Exploration

September-October 2018, Dornod

Technical Advisor: Michael MacPherson

Stage 1: Mineral Exploration

The Mining Lifecycle

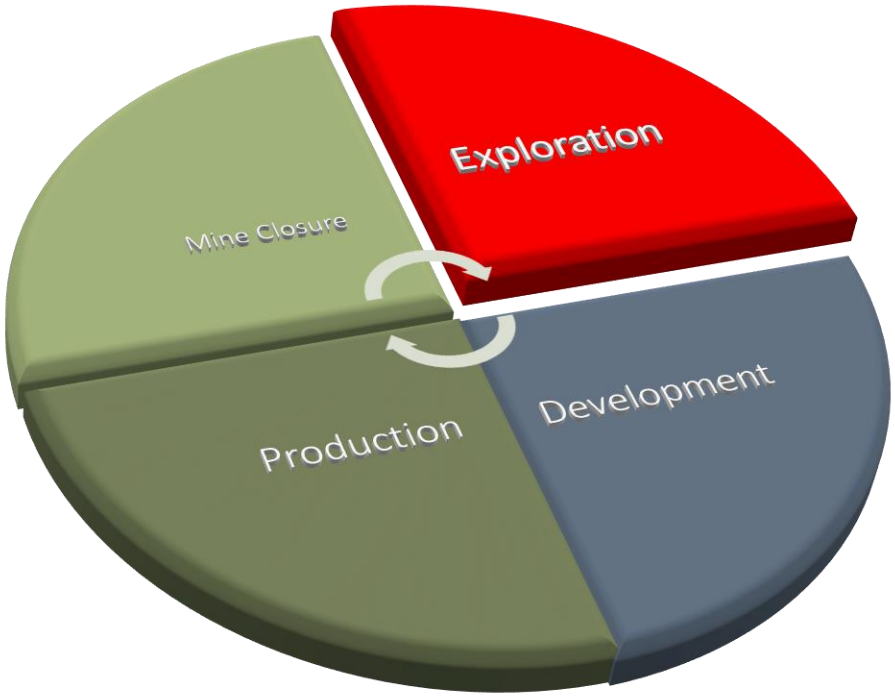
The purpose of this training is to:

1. Provide understanding of the mine life cycle
    - Exploration
    - Development and Construction
    - Production
    - Mine Closure and Reclamation
2. Understand opportunities available at each stage of the mine cycle.

Stage 1: Mineral Exploration

About Mineral Exploration

Mineral exploration is the first phase of the mining cycle. It is the search for mineral deposits that have economic value.



The purpose of exploration is to locate a new source of metal or useful minerals including:

Stage 1: Mineral Exploration

Uses of mineral and mined products

- industrial minerals (such as silica used in the making of glass
- or clay minerals used in the making of ceramics)
- metals (such as iron, lead, zinc, copper, etc.), and
- precious metals and gemstones (such as gold and diamonds).

Stage 1: Mineral Exploration

The exploration phase starts by identifying large areas that may have a certain type of ore deposit that can be developed as a resource, usually by using geoscience research and other information.

This early work involves reviewing maps, surveys and reports available from such places as the government geosciences office, old claim files and universities.

Stage 1: Mineral Exploration

Types of Mineral Exploration

- Preliminary, “greenfield” or “grassroots” exploration involves looking for a deposit in an area where the mineral has not been found before.
- “Brownfield” exploration is the search for additional deposits near a known mine.
- On-mine-site exploration is done to find additional mineral deposits on mine-sites where the minerals have already been found using new technology.

Stage 1: Mineral Exploration

The success rate is extremely low for grassroots exploration.

A Prospector would be fortunate to find one or two prospects that become a mine in his/her lifetime.

It has been estimated that fewer than 1 in 10,000 mineral showings discovered actually becomes a mine.

Stage 1: Mineral Exploration

Exploration is also a very slow, expensive and financially risky process.

For exploration programs where a promising mineral showing is discovered, it will generally take at least 7 to 10 years before the start of a new mine.

A property can be explored many times, by different companies, without success.

Properties can also change ownership many times during this stage.

Investors in exploration programs will not see any return on their money unless, and until, a mine goes into operation and starts to produce the minerals for sale as commodities.

Stage 1: Mineral Exploration

Phases in a Mineral Exploration Program

The Phases of a Mineral Exploration Program includes:

1) Geoscience Research and Mapping
2) Prospecting
3) Exploration and Sampling
4) Analysis of Mineralization
5) Determination of Economic Feasibility.

Stage 1: Mineral Exploration

1. Geoscience Research and Mapping

The first step in almost any exploration program is to conduct geoscience research.

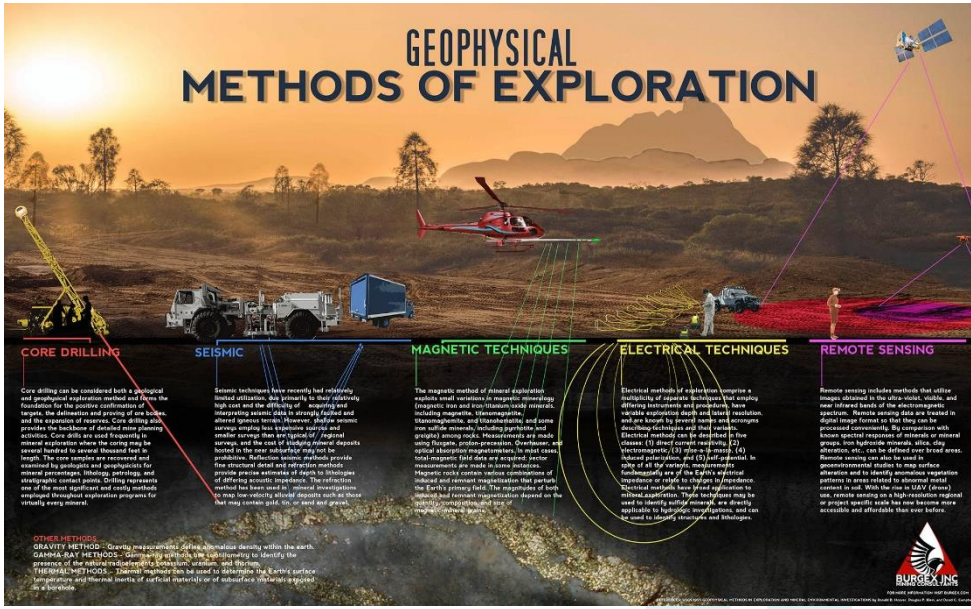
Geoscience research is the process of looking at characteristics of the earth and the earth's subsurface to determine the best places to look for "economic minerals".

Stage 1: Mineral Exploration

Methods of Geoscience Research

Geoscience research includes a number of methods to determine the surface and subsurface properties of the earth.

These methods include surveying (airborne and ground), seismic, gravitational, magnetic, electrical and electromagnetic techniques.



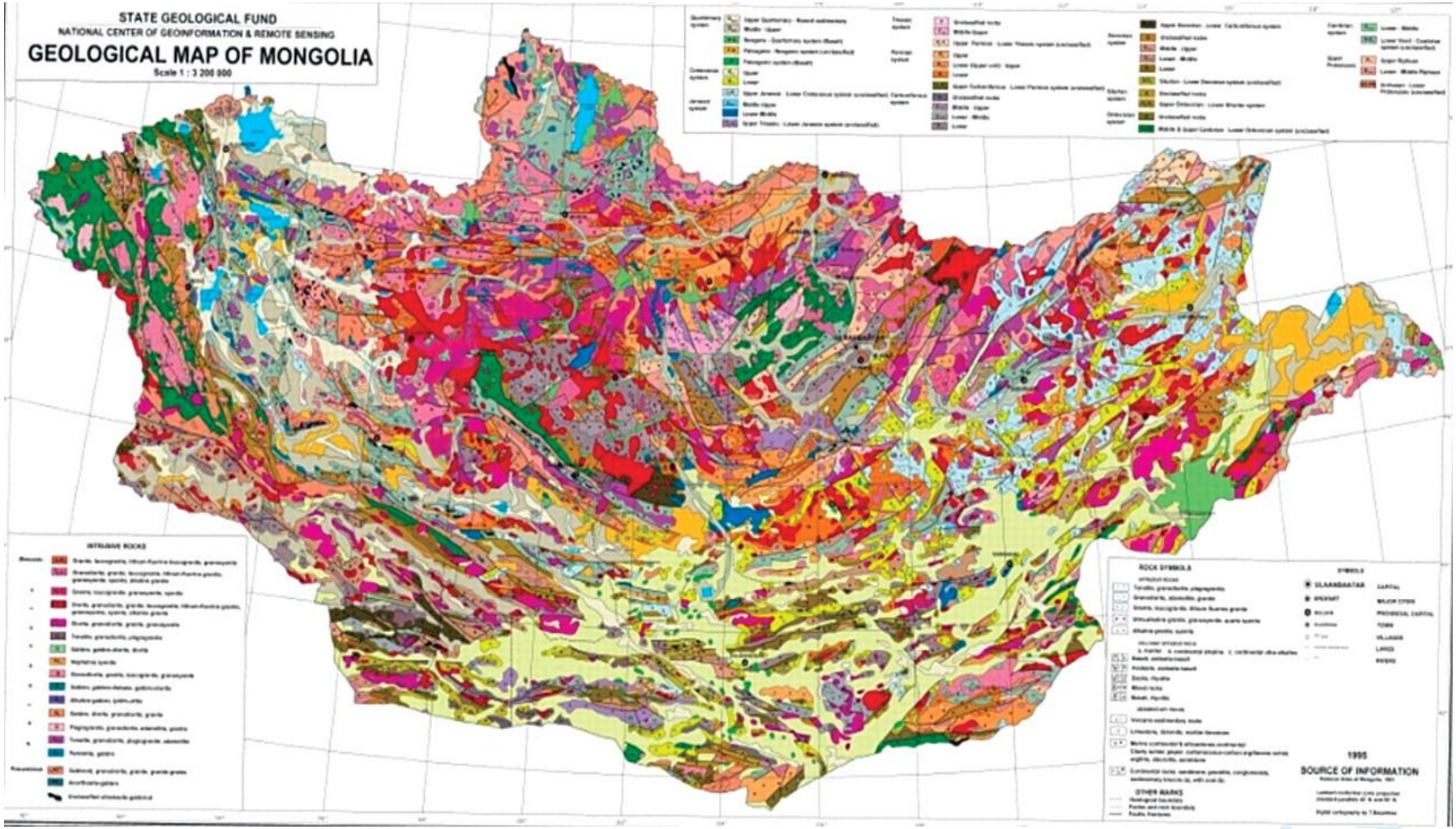
Stage 1: Mineral Exploration

Geoscience research is mostly conducted by agencies such as the Government Geoscience Office or universities.

Prospectors and exploration companies use this information, as well as other research including old mining claims, maps and other data to determine the best places to look for economic minerals.

Geoscience research results in maps, information and surveys that can be used to detect “anomalies”, or areas that indicate the presence of economic minerals.

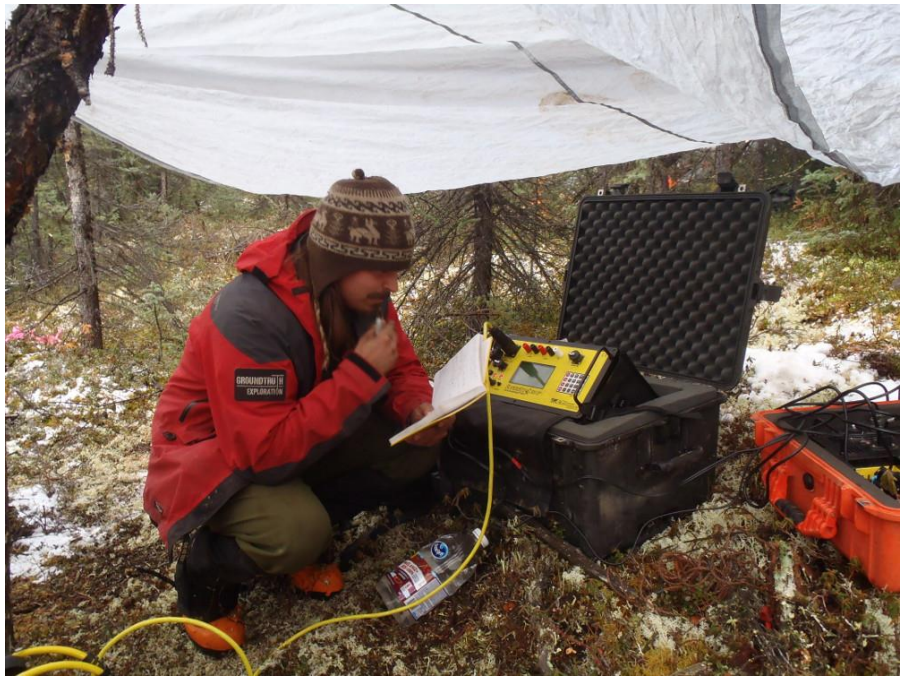
Stage 1: Mineral Exploration



Stage 1: Mineral Exploration

Ground Geophysical Programs

Ground geophysical programs use instruments in the ground to conduct detailed analysis of the surface and subsurface.



Detailed surveys have much smaller traverse line spacing and are usually done for:

- Direct prospecting for magnetic ores like iron or kimberlite, and
- Indirect prospecting using other methods to help determine the likelihood of finding economic minerals.

Stage 1: Mineral Exploration

Mapping and Research

A key part of exploration research involves reading and understanding maps such as the ones shown in the earlier slides.

Prospectors and exploration companies use geological maps, research, old drill programs and other materials to locate the best areas to explore for minerals that could lead to a mine.

Basic geoscience surveys, such as geological mapping and even satellite coverage, help guide the search for a mine.

Stage 1: Mineral Exploration

2) Prospecting and Claim Staking

Prospecting is the hunt for mineral deposits and is critical to the minerals and mining industry.

Without Prospectors, many mines may not have been started.

It is the least disruptive exploration activity and generally takes place in summer.

It is highly competitive and therefore a very secretive activity until the Prospector has secured a mining claim.

Stage 1: Mineral Exploration

Prospecting can take many forms, from a Prospector walking through the steppes with a rock hammer to using GPS systems to identify exact positions of minerals.

It largely includes Prospectors conducting preliminary research and then walking the ground examining and mapping rock types, and collecting rock and soil samples by hand for either mineral or chemical analysis.

If there are signs of minerals, prospecting activities progress to more detailed exploration programs.

Stage 1: Mineral Exploration

Claims Staking

If a prospector makes a promising find, he/she will want to acquire the mineral rights or “stake claims”. Most countries require some form of license in order to acquire mineral rights.

Once claims are staked and the mineral rights are acquired, the prospector or company has the exclusive right to explore that piece of ground for a certain period of time. This does NOT mean that the prospector or exploration company owns the land; it just means that no one else can conduct exploration work or proceed to develop a mine on these staked lands.

Stage 1: Mineral Exploration

Areas generally not open for mineral rights acquisition can include:

1. Land in a registered plan, subdivision, or town site,
2. Parks or other protected areas
3. Land already staked by another prospector, exploration or mining company, and
4. Land occupied by a building or a residence

Stage 1: Mineral Exploration

Lands for special needs (Law of Mongolia on Land, Article 16)

- lands under special state protection;
- border strip lands;
- lands provided for ensuring national defense and security;
- land specified for foreign diplomatic missions and consulates, as well as resident offices of international organizations;
- land for scientific and technological tests, experiments and sites for regular environmental and climatic observation;
- inter-aimag reserve rangeland;
- hayfields for government fodder reserves;
- contracted oil exploration sites to be utilized in compliance with the production sharing agreements;
- free zone areas;
- land allocated for the purpose of build and utilize nuclear facility;
- land allocated for artisanal mine;
- border port zone;
- area where national level development work and infrastructure project/program are to be implemented
- place where dangerous and hazardous waste are to be kept
- Aimags, the capital city, and soums may take land for special needs of the local government for the purposes referred to in provisions 16.1.1, 16.1.6, 16.1.7 and 16.1.11 of this article.

Stage 1: Mineral Exploration

Reserved areas (Minerals Law, Article 13)

Establishment of reserve areas in exploration and mining license areas shall be resolved by a decision of the Government for the following purposes:

- improve the quality of the registry of licenses;
- resolve boundary disputes among license holders;
- conduct geological research, minerals exploration and mining through State Budget funding.

Stage 1: Mineral Exploration

#	SOUM NAME	MINERAL LICENSE			WIDESPREAD MINERALS LICENSE			PETROLEUM
		TOTAL	MINING	EXPLORATION	TOTAL	MINING	EXPLORATION	
1	BAYANDUN	59	21	38				
2	DASHBALBAR	33	8	25				
3	BAYANTUMEN	18	8	10	1		1	1 / XVIII /
4	CHOIBALSAN	18	10	8				1 / XVIII /
5	GURVANZAGAL	15	2	13				
6	MATAD	10	6	4	3		3	2 /XIX, XX/
7	KHALKHGOL	10	5	5	1		1	1 / XXI /
8	BAYAN-UUL	5	3	2				
9	BULGAN	5	3	2				
10	TSAGAAN-OVOO	3	1	2				
11	CHULUUNKHOROOT	3	1	2				
12	KHERLEN	1	1		5	1	4	
13	KHULUNBUIR	1		1				
14	SERGELEN	1	1					
	TOTAL	181	69	112	10	1	9	5

Stage 1: Mineral Exploration

3) Exploration and Sampling

Once a claim has been staked, and there is reason to believe there are economic minerals, an exploration program may begin to determine if the is a mineral occurrence is worth further investigation.

Exploration programs are a more detailed analysis of the area using a variety of sampling methods.

Many mineral deposits are not exposed at the surface of the earth, but are buried beneath the soil, in glacial **tills** or in other rock formations.

Stage 1: Mineral Exploration

At this stage, the community may notice increased activity on the ground and helicopters or small planes carrying special instruments and setting up camps.

While initial prospecting usually involves taking small samples, exploration programs will generally use more sophisticated sampling methods such as ***trenching*** or ***drill programs.***

If initial work indicates that there is the possibility of a large or valuable mineral deposit, the Prospector or exploration company may take more samples to estimate the extent and shape of that mineral deposit.

Stage 1: Mineral Exploration

Types of Sampling

There are several different types of sampling methods including:

- Grab Sampling –taking a sample of rock from a designated site such as an outcrop.
- Chip Sampling –taking a regular series of small chips of rock along the face of the exposure.
- Channel Sampling –obtaining samples from a contiguous rock by cutting a channel in a length of rock.
- Trench Sampling - blasting a trench and taking samples of rock from the trench.

Stage 1: Mineral Exploration

- Drill Core Sampling - drilling into a rock surface or other material with core drills that have a hollow steel tube.

- Soil sampling - taking samples from the soil to determine the level of economic elements or tracer elements to identify potential economic sources of mineralization.

- Stream/sediment sampling - collecting stream sediments to determine the economic elements as pathfinders to economic mineralization of the rocks in the area.

- Till sampling - till is the unsorted material deposited by glaciers which may indicate the presence of economic minerals, till sampling is taking samples of the material to determine whether economic minerals are present in the area.

Stage 1: Mineral Exploration

Drilling Programs

One of the most accurate, and expensive, types of sampling are drilling programs.

A diamond drill is used to cut through rock, going down hundreds of metres and bringing up lengths of cored rock (drill core).

Typically, an average drill program will cost several times the total amount spent so far in the prospecting and exploration program.

The samples are then to laboratories for analysis and the company will analyze the results.

Stage 1: Mineral Exploration

4) Analysis of Mineralization

The analysis phase is the period during and after the field program
where samples and survey information are carefully analyzed.

The purpose of the analysis is to see if the samples indicate the presence of a large enough economic mineral deposit to continue with more detailed and expensive activities, such as detailed drilling and bulk sampling, and then possibly advance to mine development.

Stage 1: Mineral Exploration

5) Determination of Economic Value

The final stage in the mineral exploration process is the determination of economic value.

This is the process used to determine if there is enough value in the mineral deposit to warrant constructing and operating a mine … to determine if the mine is feasible.

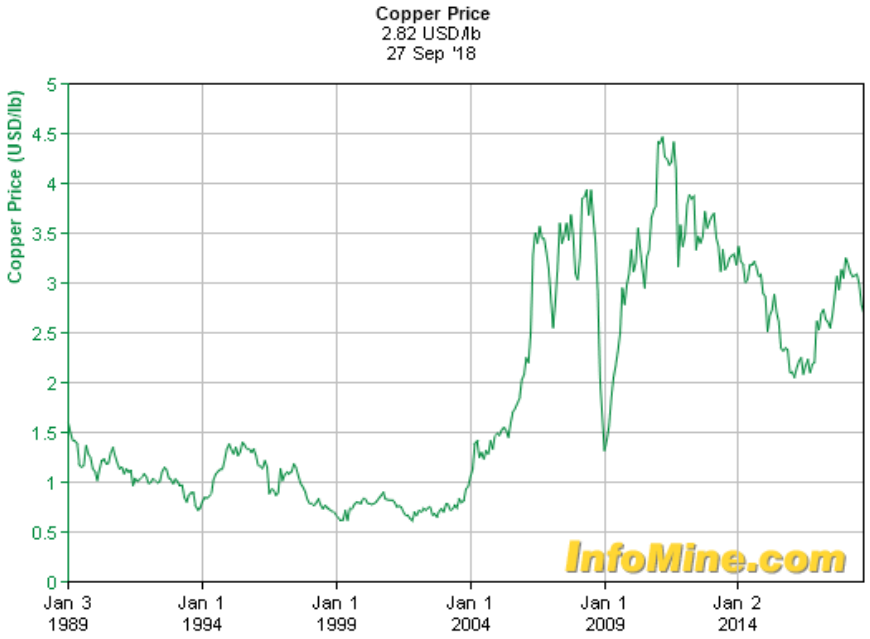
This process includes comparing the estimated “revenues” of a mineral deposit to the estimated “costs” of the mine.

Stage 1: Mineral Exploration

Revenues are estimated by estimating the amount of minerals (usually in tonnage) in a deposit times the price of the mineral.

It is often difficult to estimate exact revenues because:

- it is impossible to determine the amount of quality of the mineral deposit, and
- the price of the mineral (commodity) is likely to change over the life of the mine.



Stage 1: Mineral Exploration

Mongolian law

- Minerals Law
- Law on Widespread Minerals
- Petroleum Law
- Law on Land Subsoil
- Land Law
- Law on Geodesy and Cartography
- Law on Environmental Impact Assessment
- Water Law
- Waste Law
- Chemicals Law
- Explosive Material and Accessories Regulation and Control Law

Stage 1: Mineral Exploration

Jobs

- *Field assistant*
- *Drill helper*
- *Driller*
- *Line cutter*
- *Kitchen helper*
- *Cook, house-keeping*
- *Camp expediter*
- *Truck driver, pilot*
- *Equipment operator*
- *Trades: mechanic, welder, carpenter*
- *Environmental monitor*
- *Geologist, surveyor*

Business Opportunities

Camp construction

Expediting

Camp Services

Equipment rental and services

Drilling

Transportation and freight

Environmental baseline studies

Stage 1: Mineral Exploration

- It is important that community people ask questions, raise concerns, and learn about the exploration process and its various stages and components.
    1. What is the expected impact on the land, what is the activity, and are there any maps?
    2. What benefits will there be for local communities and people – will the benefits be temporary or permanent?
    3. What are the potential positive and negative impacts
    4. What are the employment – business opportunities
    5. How can communities participate in the environmental and social impact assessment process
    6. How will the project developer, government – respond to community concerns.