

3. The grade of the deposit must be high enough to offset all of the costs related to producing the metal or other commodity.

When we speak of the “grade” of the deposit, we are talking about the amount of metal or commodity that is contained in a ton of rock. (Note: a ton of a typical rock will fit inside a volume equal to a cube that is 2.3 ft on a side – about the size of a typical kitchen stove. The grade of a deposit can be expressed in percent (such as 0.5% copper) or, in the case of gold and silver, by troy ounces per ton (Note: A troy ounce of gold is approximately the size of 1/8” thick brass button on a man’s sport coat). The average value of a ton of ore in a deposit is estimated by first determining the grade of that ton of ore by chemical analysis (a process called assaying), multiplied by the percentage of the contained metal that can be recovered by processing, the result of which is then multiplied by the current metal price (which fluctuates on a daily basis).

To answer the above issues, numerous detailed technical studies must be completed, and these studies together often take years to complete at costs that typically run in the millions of dollars. Often these tests are done at least two or three different times during the period between the

discovery of a mineral deposit and the decision to develop a mine. Unlike many industries that get to set the price of their product (like computers, autos, etc.), mining companies must accept whatever the price is for the metal being mined at the time the metal is sold. Price decreases over which the companies have no control routinely require that complex technical studies be revised, and often completely redone.

So what about the gold discovery in Jackrabbit Flats?

Making a mine is never a sure thing – it requires time, perseverance, and above all, a significant spending of money (as much as \$100 million or more) before even the decision to develop and construct the mine is made. The total investment in a mine before any ore is mined can easily exceed \$1 billion! At best, it will be 5-10 years before there could be a mine in Jackrabbit Flats, and the hard truth is that it will likely never happen.

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The mission of the Mining Foundation of the Southwest is to promote public understanding and education related to the mining industry, both in the U.S. and abroad. mfsw@dakotacom.net



The Department of Mining and Geological Engineering is a founding department of the University of Arizona, the only mining engineering program in the PAC-10, and one of only 13 such programs in the US. www.mge.arizona.edu

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GOOD INFORMATION = GOOD DECISIONS

factual information from credible sources for public and private decision makers and for all people who care deeply about our state and national economy and our environment



What Does It Take To Make A Mine?

Why do we explore ?

The search for a particular commodity is most often driven by a favorable price and/or the need for a raw material imperative to a particular established business. The current rapidly escalating prices in certain metals (eg. gold-\$560./ oz., copper-\$3.20/ lb., nickel-\$6.90/lb.) result largely from the emergence of the two industrial giants, China and India, and their current and anticipated raw materials needs. This seemingly sudden minerals boom has required many adjustments in the mining industry: Mining engineers and geologists are in short supply as are the skilled tradesmen vital to the construction of new mines. Drill rigs are available only at a premium. Geographic areas of minerals search have dramatically widened. At present, 29 companies are exploring north of the Arctic Circle.

Where shall we search ?

With a particular commodity in mind,

Front page, business section, of a prominent Arizona newspaper – the headline reads, Gold Deposit Discovered in Jackrabbit Flats, Pima County. What does this mean?

It could mean that an exploration company had intersected just a couple of meters of gold bearing rock in a drill hole, at some unknown depth. The importance of this event may have been embellished by aggressive explorers and further enhanced by the news media. In fact, the chances of this mineral discovery being developed into a mine are at least 1 in 100, more probably 1 in a 1000. Mines are difficult to make! Exploration is but the first step.

Contributed by Al Perry and Don Earnest.

attention must be given to environments favorable to the occurrence. Gold, diamonds, copper and iron ore (for that matter all commodities, including sand and gravel) are not found just everywhere. Certain types of rocks, the involved movement of “plates” of these rocks during geologic time and the availability of particular elements within the earths crust at the time of rock formation or during some later geologic event - all of these determine the location of mineral deposits.

What about business risk ?

Areas established as geologically favorable have to be carefully compared to determine if they have other attractive features that reduce business risk. Some of these features are: government stability, favorable tax structure, reasonable royalties, acceptable depletion regulations, profits reparation and the assurance of a guaranteed progression of mineral rights from exploration through mining – ie. a guarantee of title. *Continued on page 3.*



Should royalty be paid to the Federal government?

Payment of royalty to the federal government has been one of the hottest topics of debate on most proposed changes to the Mining Law. In fact, it was debated when the Mining Law was first passed and intentionally not made part of the law based on an argument that its imposition was no different than placing an additional tax on the production of crops from agricultural homesteads being patented. The Public Land Law Review Commission also suggested that royalty should be collected on production both before and after patent based on rates being paid to other landowners for the same mineral ore in the region. These royalties, the Commission warned, would be modest and would not be a major source of revenue, but in any event should be fixed “at levels that will provide a continuing incentive for mineral exploration, development, and production on public lands.”

In many respects this debate reflects the ongoing dynamic between the federal government and the States as to taxing authority over land within each State’s boundaries. A royalty paid to the federal government would be a form of tax and would be in addition to any of the federal income taxes imposed on the enterprise. The individual States, on the other hand, have traditionally taxed both in-place values and sales (or severance) taxes on mineral production. The legislative proposals that have been submitted since the Commission’s report have ranged from a gross 12½% from the mining law’s most vocal critics to a net 2% from groups aligned with the mining industry. The 2005 Proposal contained no royalty.

Looking at the General Mining Law – Part 2

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What price should be paid for the land?

When the Mining Law was passed in 1872, the purchase price to obtain a mineral patent (that is, title to the mineral ground) was set at \$5.00 an acre for lode claims and \$2.50 for placer claims. This price reflected the than current values as agricultural land could be homesteaded for free or purchased at \$1.25 per acre. The \$1.25 per acre for most public land was initially established in 1820 and was a reasonably accurate reflection of western land values for almost 100 years. The price fixed for mineral land, while intended to reflect a reasonable value, has long since been outpaced by inflation. Many of the proposed amendments to the Mining Law have, therefore, reflected an effort to increase the “purchase price” to reflect current values. The 2005 proposal would have raised this amount to \$1,000 an acre or the current appraised value, whichever is greater.

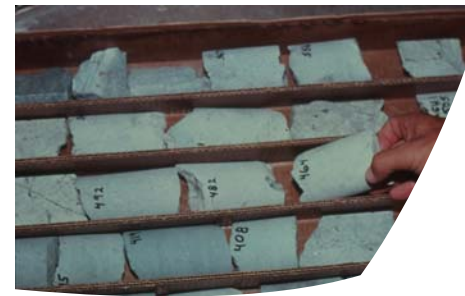
Lease vs. locate and administrative discretion

Perhaps the most contentious issue during the past 40 years has been whether the traditional “hard-rock” minerals should continue to be subject to disposition under the Mining Law’s self-initiated location and purchase system or be converted to a leasing system. At the heart of this argument is whether minerals should be privately owned and developed in response to market pressures, or government-owned and managed under a leasing system. The real issues underlying this argument are (1) whether administrative discretion should play a part in allowing the exercise of mining rights after discovery, (2) whether royalty should be paid to the federal govern-

ment, and (3) whether environmental controls should be a part of mineral tenure. The hearings on June 18, 1991, clearly defined this battleground when the Chairman of the Sierra Club, told a subcommittee that the Mining Law amendment then under consideration “should be revised to give agencies full discretion over mining” and that the administration should have the ability to deny a permit to mine. The mineral industry, in opposition has held steadfastly to its view that any citizen with the initiative and wherewithal to discover mineable minerals should be entitled to enjoy the financial benefit of any discovery found within land that had been otherwise originally open to location.

The element that has confused the argument is a differing approach over the application of environmental controls. Environmental control over all activities has increased substantially since the enactment of the National Environmental Policy Act in 1971 and the air, water and solid waste laws that followed. The Mining Law, in contrast, has traditionally been a tenure law – in other words, a system whereby legal title would be conveyed into private ownership for land that was valuable for its minerals. Thus, many argue that the mineral law should include its own separate environmental controls, most industry advocates has argued that the Mining Law should focus on tenure and that environmental controls should stand on their own.

Whatever the final shape the Mining Law of the United States, the result will have a significant effect on whether the United States will have a domestic mining industry or if mineral resources will be imported from elsewhere.



Exploration is high tech and high risk

In 2004, the budgets for 1,100 exploration companies averaged about \$3.5M per year.

How do local conditions affect exploration ?

A number of other considerations go into the mix that determines where exploration is commenced. Some of these are: physical access, proximity to markets, availability of a reliable labor force, water supply, attitudes of the surrounding populace relative to mining and availability of sufficient land for mine and support facilities. In some cases, the most attractive exploration targets are situated in withdrawn areas, eg. Federal and State Parks and Monuments, military reservations, some Indian lands. Other lands in close proximity to heavily populated areas are, in effect, withdrawn from exploration.

What really happens during exploration ?

At the start of exploration non-intrusive tools are commonly employed. Geologic maps are studied and often these maps are prepared from satellite images or aerial photographs. Airborne geophysical surveys are conducted. These surveys permit the measurement of such rock features as: density, magnetism and radioactivity; features that often reflect the presence or absence of the mineralization sought. Faults, shattered rock units and alteration can most often be recognized.

Target areas can be further defined using similar ground based geophysical surveys. More “hands-on”, site specific, work is then employed. Vegetative, stream sediment, soil and rock sampling may be undertaken. With the use of a hand-held GPS (Global Position-

ing) unit accurate positions of samples can be obtained without the necessity of cutting of lines in areas of heavy vegetation. Using these environmentally safe, non-invasive tools results in negligible exploration “footprints”. Collected samples are analyzed for mineral content; generally reported in trace amounts (parts per million, parts per billion or percent).

Once one or more detection methods give evidence of a possible target area, drilling may be conducted. Drilling may either be coring, a process that yields a “stick” of rock, generally of small diameter (often 1-13/16ths or 2-1/8ths of an inch). Non-core drilling (rotary drilling) yields a sample in the form of rock chips. The initial spacing of drill holes varies with the target configuration. With good results, drilling patterns will tighten as the development phase is entered.

However !

Even after several million dollars have been spent on exploring for and discovering a mineral deposit, there is no guarantee that the deposit will ever become a mine. There are many conditions that must be met before the rock containing the potentially valuable metals can be called “ore”.

1. The ore must be able to be safely mined.

The rock that contains a mineral deposit is often badly fractured, which creates safety issues related to the stability of the walls of an open pit and the roof and sides of underground working areas. Poor rock strength increases the

EXPLORATION: Quick Facts

The odds of a mineral discovery becoming a mine are about 1 in 1,000.

Exploration and feasibility studies can cost \$100 million or more and take 5-10 years to complete.

A new mine can cost over \$1 billion to develop before ore is mined.

A troy ounce of gold is about the size of a sport coat button.

cost of the mine. Also, in underground mines, the cost of the ventilation shafts and other airways, and equipment required to maintain a safe working environment in the mine is a significant portion of the cost of developing an underground mine.

2. The metal or other commodity must be recoverable by feasible processing methods.

Even though a mineral deposit can be very high in grade, it is worthless unless the metals can be recovered from the rock. Processing often requires crushing the rock containing the metal down to a small size, such as less than one-half inch in diameter (about the size of a seedless grape), and then grinding it in a mill to a very fine sand, or in some cases as fine as talcum powder. The ground rock is then treated with different types of chemicals to either concentrate or sometimes dissolve the metal from the rock. The test work needed to determine the metal recovery percentages before a mine is developed is extensive, time consuming, and expensive.

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