

ICMJ's

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# PROSPECTING and **MINING JOURNAL**

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**GOING OVER OLD GROUND  
WITH NEW TECHNOLOGY**



**PROSPECTING  
IN THE AGE  
OF COVID-19**

**HARD ROCK 101:  
BREAKING ROCK**

**PLP UPDATE:  
REGULATORY  
RELIEF IS  
ON THE WAY**

**PLUS:  
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## LEGISLATIVE AND REGULATORY UPDATE

### • Congress deals with other priorities

With the coronavirus being the main focus of attention at both the state and federal level, there was no significant mining legislation to report on over the past month. We did, however, receive word from Trump administration officials that several of our proposed regulatory changes/improvements are moving toward publication in the Federal Register and this is very welcome news. Take a look at the PLP Update column on page 28 for more on this topic.

### • Alaska miners get relief on state lands

The State of Alaska legislature passed SB 155, which provides clarity for exploration and mining rights on state lands, allows miners a clear path to cure filing errors, and provides clear definitions of annual labor and what activities satisfy annual labor requirements.



## HARD ROCK 101: BREAKING ROCK— PART I

by John Norman

What do you do when you've located a promising deposit of gold or gemstones, but it's trapped in solid rock? How do you get to virgin ground when it's under a boulder larger than a car? We're going to find out what it takes.

Hard rock mining is the process of drilling, breaking and removing material that is part of a solid, massive lode that can't simply be shoveled into a truck. Mining is one of the oldest human activities, and it evolved as technology advanced from stone tools and fires, to iron drills and wedges, to explosives and large powered equipment.

### Hard Rock Basics

Before we get into the nuts and bolts of rock breaking for the small miner, we should go over some basics. First, rock is generally a very strong

material in compression. We make walls and foundations out of it and it can withstand many thousands of pounds per square inch pressing down on it. If you've ever tried hammering on the surface of an exposed rock, you probably found that a lot of effort was needed just to sample a few chips.

When under tension, however, rock is much weaker. This is the principle we are going to exploit later. The basic idea of rock breakage involves getting access to the inside or back of the material we wish to break, then applying force in a way that pulls it apart. We will discuss how to get access (primarily by drilling holes) and then various ways of applying force (wedges, expanding grout, explosives).

### A Word About Safety

All of the techniques we will be discussing can be dangerous. Any time we drill or hammer on solid rock, we generate flying rock chips. The tools we use are made of very hard steels that can spall and make steel splinters. Eye protection is 100% mandatory and appropriate work gloves are necessary.

The dust produced from drilling and jack hammering should also be assumed to contain silica, especially when working any type of rock that contains quartz. Silica dust causes devastating illnesses, such as lung cancer and silicosis. An N95 or P100 mask with a good seal should always be worn when drilling rock, and the work should be wetted down with water whenever possible to suppress dust.

When you break up and move large amounts of rock, you are also dealing with stored energy. When blasting, it's common that some rocks will fly into the air, so wear a hard hat anywhere rock can come down on you. Assume that anything that could fall or roll onto you eventually will, and keep body parts out of its path. Nobody wants to hear about how you became the one-armed miner of Death Valley. Finally, drilling and hammering generates a lot of noise,

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so use common sense and wear ear protection whenever you operate loud machinery.

### Rock Drilling 101

The first step to separating ore from the host rock is getting behind it by drilling. The old-timers used muscle power and a chisel-shaped drill steel called a "single jack" or a "double jack." The basic idea is to hit the single jack (usually with a 4 lb. "drilling hammer"), turn it, and repeat over and over. Double jacking is the same thing, except done with an 8 lb. sledge hammer and a two-man team.

The percussion of steel hitting the rock fragments it and drives the drill deeper. Turning the drill steel moves the chips out of the way and positions it for the next blow. Modern hammer drills (electric, gas or pneumatic) do exactly same thing, just faster. All of them use a combination of "whacking and turning" to drive the drill bit into the rock. Most modern drills include some way of removing the cuttings, either with air/water flushing or with spiral flutes on the drill bits.

### How to Drill

All drilling works basically the same. You want to start with a short drill bit to "collar" or get the hole started. Short drills are stiff and make starting easier. Once you have drilled as deep as you can, you then switch to a longer drill. This continues until the desired depth is reached. Switching steels helps keep the drills from overheating, keeps the hole going straight and makes it easier to operate.

### Drill Bits

Drill bits are available in different configurations to make drilling very hard or very soft rock easier. Larger drills take "steels" with a replaceable "bit" attached to the end. Smaller drills use a disposable, one-piece bit. Drill bits are a "wear item" and must be changed when dull. Only quality carbide-tipped drills should be purchased.

The smaller drills used in cordless and electric drills can usually be used in sequence to ream out a hole to a larger diameter. Most air drills use bits with a flat face that must *not* be used in this way, unless they are specialized "reaming" bits.

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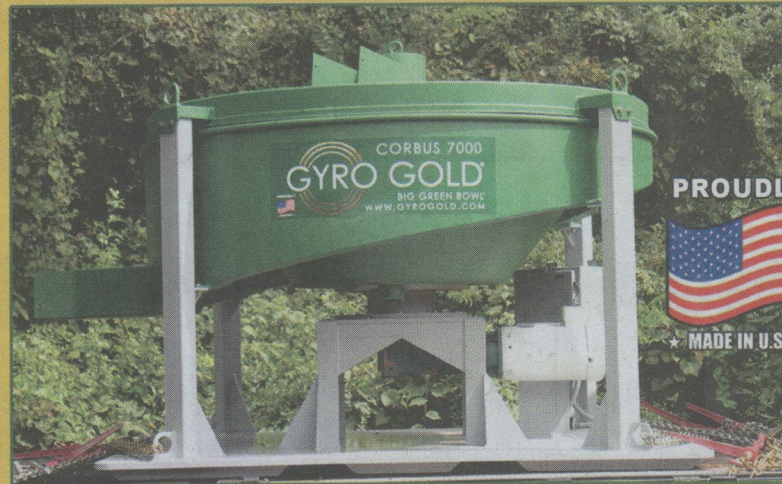
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J.T. - 405-605-9853 [jt@gyrogold.com](mailto:jt@gyrogold.com)





### Drilling Machinery

As a small-scale operator, you have a choice of hand drilling (not recommended, but still possible if you can find the tools), cordless hammer drills from 18V-40V, gasoline-powered drills, electric hammer drills powered from a generator, and the "big guns," pneumatic drills that are powered by a towable air compressor.

### Cordless Drilling

With lithium batteries now standard, cordless hammer drills have become much more useful for mining. A lithium-ion battery-powered 18V-20V model with 2 amp-hour batteries can drill several deep 1/2" or 5/8" holes on one battery. The larger models can drill one or more 1" holes and can do it in one pass. Cordless drills are an excellent, portable way to make holes for micro blasting (more on this later) or inserting wedges for splitting. Cordless tools are also much safer to use underground, as they won't electrocute you if they get wet and do not generate toxic fumes.

If you are looking to get a cordless hammer drill, get one that takes SDS+ bits (the most common) and rated for 1" if possible. The lighter cordless drills are great for setting small expansion bolts, but won't hold up to continuous drilling of deep holes. Be sure it has a "hammer only" mode for use with a chisel bit.

Also, buy the largest battery pack available. Not only will they drill more holes per charge, they are less likely to overheat and shut down. A 1/2" hole about 24" deep can easily be drilled with a cordless drill. Larger holes can be done in several passes.

### Electric Hammer Drills

The next step up in drilling machinery is the 110V or 220V electric hammer drill. These take SDS+, SDS Max, or larger spline-shank tools. These drills are large, professional-use tools that must be run from a generator and extension cord. They are expensive and big enough to hurt you.

Most of them can drill 1" or larger

*(Top) Heavy-duty cordless hammer drills can be used to drill short holes in rock for breaking or blasting. Multiple batteries are a must for this type of use.*

*(Bottom) Motorized jackhammer drills like this one are powered by a gasoline engine and have long been used by small miners for surface blasting operations.*

holes without too much trouble and can also serve as a jackhammer. Most of these have a variety of tools other than drills available, such asmoil points for breaking, spades for digging hard dirt or soft rock, and ground rod drivers. These tools are an excellent choice for drilling holes to use expanding grout or for hammering out already-broken rock.

I would recommend renting one of these before buying, as they cost over a thousand dollars new. Holes from 3/4 - 1 1/2" and up to 36" deep or so can be made with a quality electric hammer drill.

#### Augers: Great for Dirt, Not Rock

One- and two-man gas-powered augers are available to buy or rent. They are excellent if you need to set claim posts or sample placer sands. These are easily rented at any tool shop. Keep in mind that these have no percussion action, and will not work whatsoever on rock.

#### About Gas-Powered Tools

Another, often overlooked category of portable machines are the gas-powered drills and breakers. There are a variety of small drills that will do similar work to a mid-sized electric hammer drill. They are sold under different names and usually made in China. They work okay if used within their limits, although spare parts and support are a definite issue.

A nice all-purpose machine for surface mining is the old Swedish-made "Pionjar" series. This is a 55 lb. combination drill/jackhammer. It has a 185cc 2-cycle gas engine and it's a beast. You can drill 2" holes through solid rock at about 1 foot per minute, and they accept industrial-quality 7/8" x 4 1/4" drill steels and tools used in pneumatic drills. These were very popular during the uranium boom in the 1950s. They are used extensively by trail maintenance crews. (China is now producing copies under the same name—buyer beware.)


One drawback to these drills is their cost; they sell for about \$5,000 new. Rebuilt units are often available for 1/2 - 1/3 that cost. These are an excellent choice if you want to drill lots of 1" to 2" diameter holes for blasting or heavy-duty breaking with expanding grout.

#### Pneumatic Drills: The Big Guns!

If you have a large number of holes



*This motorized jackhammer drill is very handy for small mining operations, but the holes must be at least close to vertical because it's just too heavy to hold in a horizontal position and it cannot be used underground because of the exhaust fumes.*




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to drill, nothing beats renting a pneumatic drill and compressor. Rock drills are classified by their weight. They range in size from one-handed

“9 lb. class” drills suitable for putting 1” holes in boulders up to 90 lb. class sinker drills that can make a 3” hole, 12’ or deeper.

Air drills up to about 30 lbs. can be used either as a “sinker” drill to put vertical holes in rock or muscled into drilling horizontally. A jackleg drill with a powered pneumatic support leg is used for heavy drilling in walls, such as underground mining.

If you decide to rent a drill, be aware that even a very small one uses a lot of air. Expect to also rent a 185 cfm diesel-powered compressor trailer with it. You’ll also need 50-250’ of 1/2” or 3/4” air hose, and a selection of drill steels. Make sure the air hoses come with safety pins, so that the sections cannot come loose. An oiler should also be included, as air drills get their oil from the air supply.

Check to see what type of steels the unit you are going to use requires. Pneumatic drills take “steels” or metal shanks that are fitted with the bit on the end. They come in three main sizes in the US; 7/8” wide with either 3 1/4” or 4 1/4” long hexagonal shank, or 1” x 4 1/4”. There are multiple types of bits for the end—H-thread, rope thread, knock-off, etc. Whatever they are supplying, make sure it all works together or that you ordered the right bits ahead of time.

Expect to pay \$200-400/day to rent this equipment, plus fuel, oil and bits.

## Rock Breaking 101

This will be covered in more detail in part 2. For now, let’s go with the premise that there are three primary methods we can use to break the rock we just drilled.

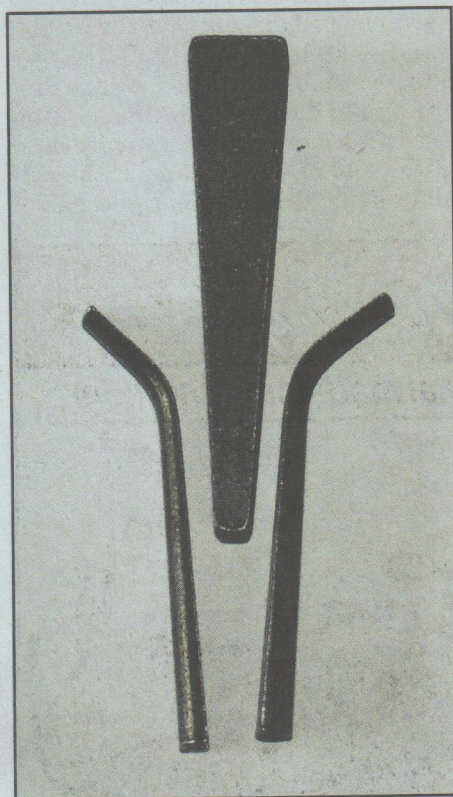
**1. Feathers and Wedges.** This is an ancient technique that is still used by stone masons. It involves drilling a line of holes, setting two greased steel “feathers” in each, then driving a wedge in to place tension on the rock. As the wedges are hammered down in sequence, cracks begin to form and then connect between the holes. These tools are still available from stonework suppliers.

**2. Expanding Grout.** Special grout products are available that can be mixed, poured into holes, and left to set and expand overnight. Within 24 hours, they achieve breakage, similar to the above but at a larger scale. This can be special-ordered from a hardware store; search for “expanding grout for rock breaking.”

**3. Explosives.** Blasting isn’t just dynamite anymore. There is such a thing as “micro blasting” that can be done by anyone with simple training. There are various types of high explosives, and now there are also special pyrotechnic cartridges that are a sort of in-between.

Happy mining!

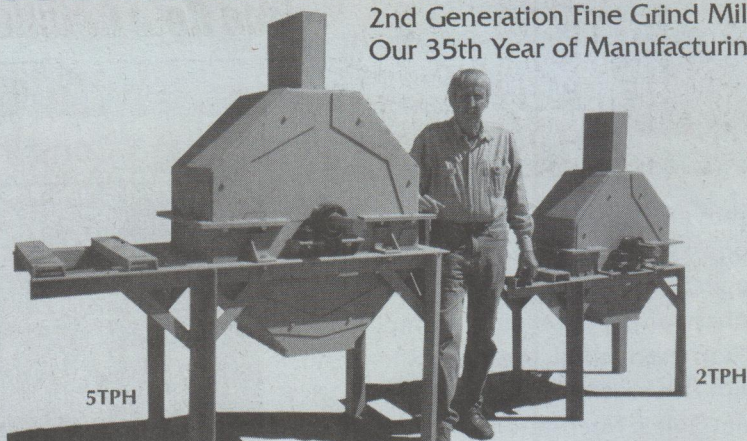
*The author been involved in prospecting, rock hounding and amateur mining for 20+ years and is a licensed blaster. He currently serves on a Search & Rescue team that covers abandoned mines and other underground rescue in San Bernardino County, CA. He welcomes questions via email at: [jnorman@accxproducts.com](mailto:jnorman@accxproducts.com)*



*The wedge and feather set shown here is the ancient way of cutting or breaking rock. A series of these set in a group of holes drilled in a line is a time consuming but very effective way of breaking rock.*

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