Finding the right balance (RC or Core)

Time cost, and quality are the three most important factors in exploration drilling. Used in combination, the two most common methods of rock sampling will provide mines with an optimum balance.

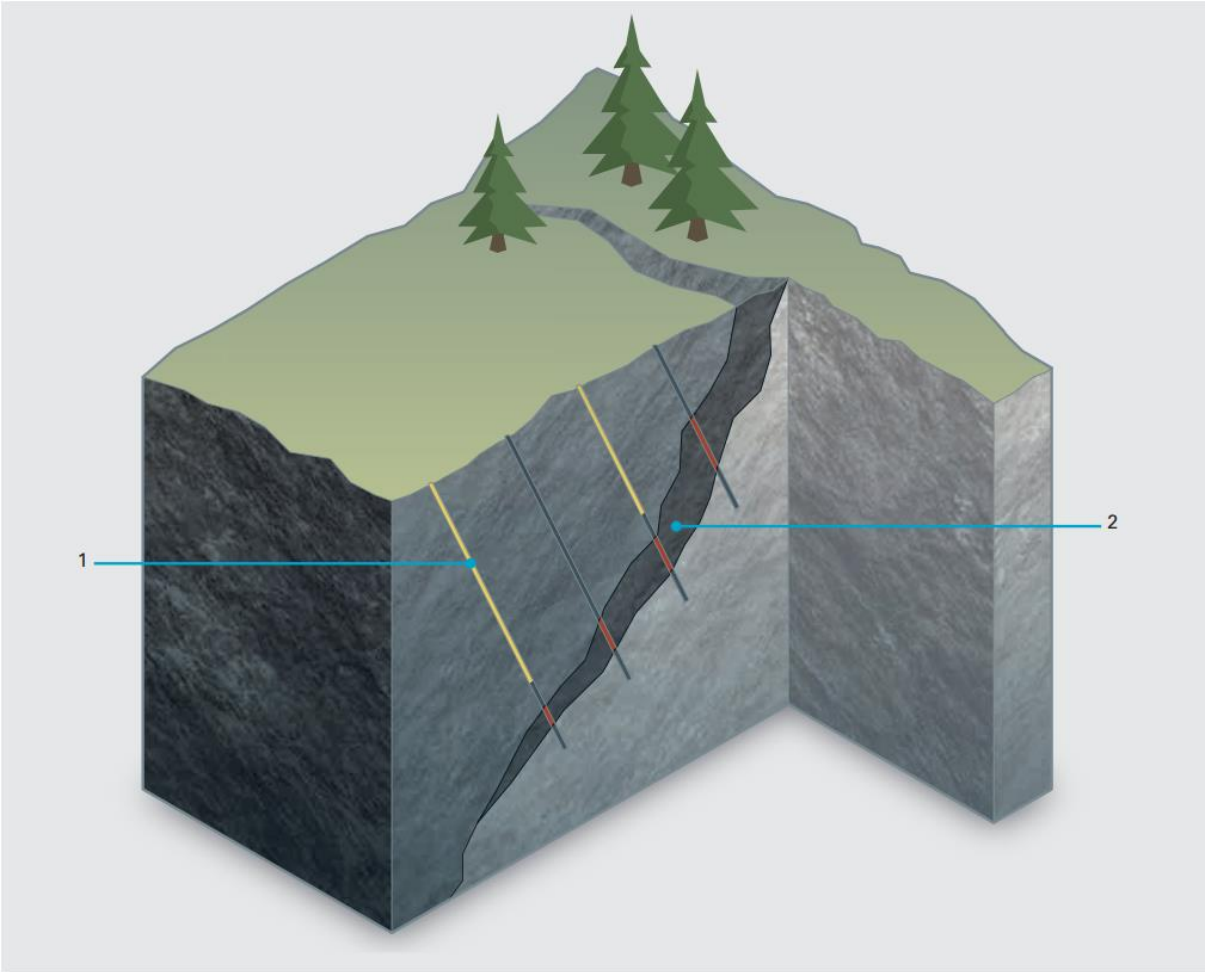


Figure 1: 1. Pre-collaring of holes. 2. Mineralized zone where chip samples (RC) and/or cores will be extracted.

Chips or cores? That is the question faced by geologists and exploration drilling contractors. And the answer today, in most cases, is both. In the search for minerals and precious metals, the quality of ore samples is the single most decisive factor. But as exploration is both a costly and time-consuming process, a combination of reverse circulation drilling and core drilling can be a useful approach to optimize the process.

As with all forms of drilling, there are pros and cons associated with these methods. RC drilling is a faster and more economical way of pre-collaring holes and is especially suitable if the driller is simply charged with reconfirming the ore boundary. RC drilling technology has become so advanced that more and more geologists now believe that chips are perfectly sufficient as a means of determining ore content.

However, this said, when it comes to obtaining detailed studies of the characteristics of the ore and host rock, core drilling is the method of choice. Not only does core drilling provide more comprehensive data, it can also be conducted in difficult conditions at depths as far down as 3 000 metres.

Combining methods – When and Why?

With increased pressure on mines to save costs in all operations, the combination of core drilling and RC drilling means that significant time savings can be achieved. But not all infill drilling needs rock mechanics analysis, and this is where RC drilling may well be the better choice as it is both faster and cheaper. Once the general location of the mineralized zone has been established, savings can be realized by using RC drilling at the initial pre-collaring stage through overburden, before the orebody is reached. The driller can then decide whether to continue with RC drilling to extract chips of ore, or to switch to diamond core drilling to extract cores, which enables more advanced analysis of the ore and host rock for infrastructure. In this way, RC drilling becomes the perfect complement to conventional core drilling.

As shown in Figure 2, the RC method can be used to drill enough pre-collars to keep three core drilling rigs running for 24 hours a day. In this scenario, a minimum of 25 % of the total meters drilled are specified as core drilling. The total cost of core drilling is higher compared to RC drilling, however, experience shows that a combination is recommended in order to achieve the right balance between productivity and costs, as can be seen in Figures 2 and 3.

Total drilling program 80 holes, 400 m deep.
Total 32 000 m of drilling

Scenario 1	
100% core drilling 457 days	70 m core / 24 hours with 1 core drilling rig
Scenario 2	
50% RC (pre-collars only) 50% core drilling 301 days	70 m core / 24 hours with 1 core drilling rig
Scenario 3	
75% RC (pre-collars & full holes) 25% core drilling 223 days	70 m core / 24 hours with 1 core drilling rig

In case three core drilling rigs would have been available in scenario 1, expected time is 152 days compared with 457 days.
In case three core drilling rigs would have been available in scenario 2, expected time is 149 days compared with 301 days.
A rough conclusion is that the RC rig is somewhat faster than three core drilling rigs together.

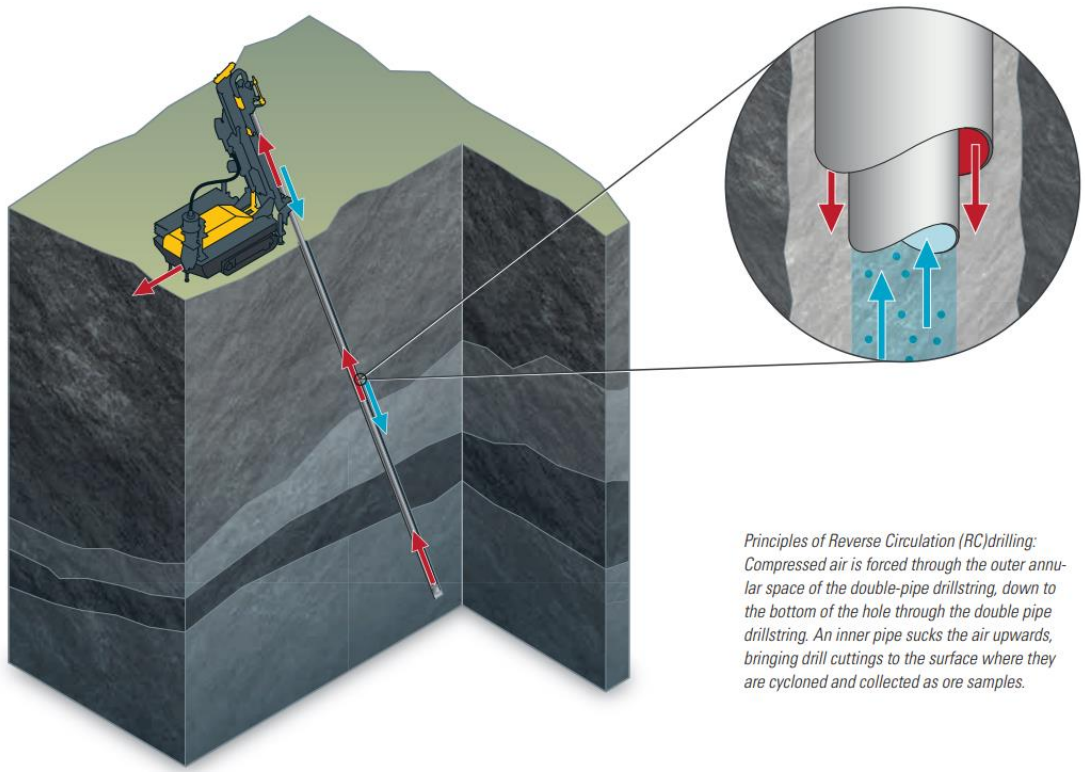
Figure 2: Alternative approaches to a major exploration drilling campaign.

Cost ratios	U.S. dollars
457 days	2 580 000
301 days	740 000
223 days	320 000

Approx. cost of RC drilling - 30 U.S. dollars / meter
Approx. cost of core drilling - 80 U.S. dollars / meter

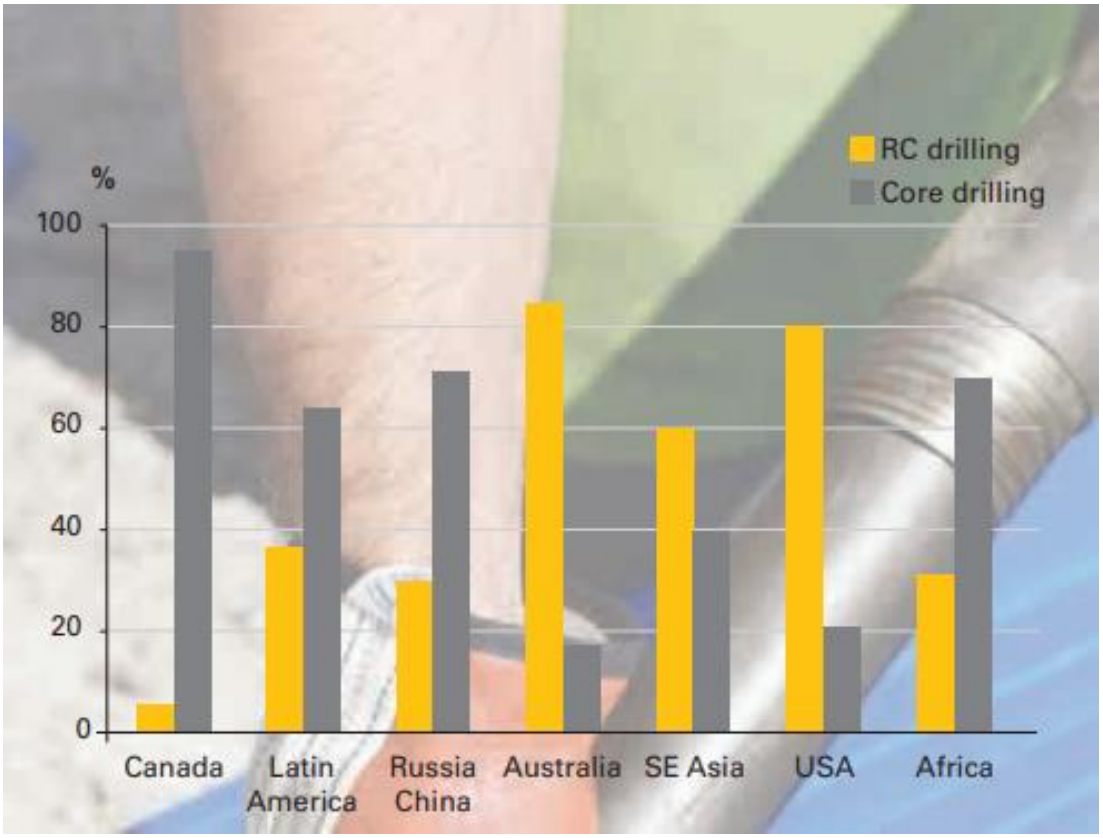
Figure 3: Costs of exploration drilling (approx.) based on the above drilling scenarios.

In this example, we can see that both time and costs favour RC drilling. The figures are easy to evaluate. They vary depending on the location and the local conditions, but the comparison remains the same.



Principles of Reverse Circulation (RC)drilling: Compressed air is forced through the outer annular space of the double-pipe drillstring, down to the bottom of the hole through the double pipe drillstring. An inner pipe sucks the air upwards, bringing drill cuttings to the surface where they are cycloned and collected as ore samples.

Traditionally, core drilling rigs have been better suited to remote and sensitive environments thanks to their light weight, but this is rapidly changing as new equipment arrives on the market. In extremely cold climates and where permafrost is present, RC drilling has some limitations, but antifreeze rock drill oil can help to keep the hammer and bottom of the hole free from ice.



Data to the lab

As a rule, geologists require samples that are dry and representative. But how do cores and chips compare in the laboratory? When it comes to cores, the information they can provide is crucial in estimating the extension and grade of mineralized structures. Cores also yield geotechnical data such as rock mechanic structures, which can be vitally important when planning an underground mine.

Although technology is tightening the gap between RC drilling and core drilling – roughly 55 % of all exploration work uses the RC technique – the most important factor for geologists and mine planners is to maintain a high level of confidence through findings. This, confidence, will determine how exploration projects continue. and can be calculated using the formula.

The equation is simple: confidence over time multiplied by cost equal's profit.

$$\frac{\text{Confidence}}{\text{Time}} \text{ x Cost} = \text{Profit}$$

For underground operations, the use of diamond core drilling is much greater because as rock mechanic analysis is often a fundamental requirement. That said, both chips and cores are integral factors, and will most likely be joined by others as innovative solutions for probing the world below us emerge.