Why Drilling Sample Quality is so Critical

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Unlocking the Benefits of Better ‘Driller-Geologist’ Partnerships
AIGWA-ADIA Seminar

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The Critical Sample

HQ core
Volume = \( \pi r^2 h \)
0.0317m\(^3\)

Area of drilling
Volume = 100 x 100 x 10
100,000m\(^3\)

This HQ diamond drill hole is sampling ~0.000032% of the total volume needing to be tested!
The Critical Sample

100x100m grid
4 holes
Volume ~ 0.00013%
Inferred

50x50m grid
9 holes
Volume ~ 0.00029%
Indicated

25x25m grid
25 holes
Volume ~ 0.0008%
Measured
Setting the Scene

Why are we drilling?

What is the drilling sample?

What goes wrong?

How do we achieve and maintain quality?
Why are we drilling?

• Information for Risk Assessment and Analysis

• Meet requirements for JORC, NI 43-101, SAMCODES etc

Every company wants to find the biggest orebody in the world!
Why are we drilling? (continued)

- Exploration
- Resource definition
- Grade control
- Density
- Ore type assessment (geometallurgy)
- Geotechnical and structural

Often we do not capture all the information that we could from the drilling sample!
Why are we drilling?

- Geotechnical and structural
- Environmental management
- Pit designs and tailings dam designs
- Groundwater assessment
### What is the drilling sample?

<table>
<thead>
<tr>
<th>Drill method</th>
<th>Cost</th>
<th>Sample type</th>
<th>Sample quality</th>
<th>Uses</th>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auger</td>
<td>Low</td>
<td>Soils, chips</td>
<td>low</td>
<td>Early exploration, close to surface</td>
<td>Cheap, fast</td>
<td>Restricted to soft unconsolidated material, usually close to the surface</td>
</tr>
<tr>
<td>RAB (Rotary Air Blast)</td>
<td>low</td>
<td>Drill chips</td>
<td>low</td>
<td>Early exploration; shallow depths; base of regolith</td>
<td>Very fast</td>
<td>Samples can easily get contaminated; limited depth of penetration</td>
</tr>
<tr>
<td>Air Core</td>
<td>low</td>
<td>Drill chips and small chunks of rock</td>
<td>Low to medium</td>
<td>Soft rock; weathered regolith</td>
<td>No casing of holes; greater depths achieved; easy transportation; Similar method of sample recovery as RC; More representative sample than RAB</td>
<td>Higher cost than RAB drilling</td>
</tr>
<tr>
<td>RC (Reverse Circulation)</td>
<td>moderate</td>
<td>Drill chips</td>
<td>Reliable</td>
<td>Geological models; Resource definition</td>
<td>Cost; Faster completion of hole; Reduced manhours on the rig; Simplified sampling process; Less water needed for drilling;</td>
<td>Less geological information; Holes can deviate; Usually drills to less depths than diamond;</td>
</tr>
<tr>
<td>Diamond</td>
<td>high</td>
<td>Core</td>
<td>high</td>
<td>The recovered core can yield a high degree of geological and structural information</td>
<td>Slower; expensive</td>
<td></td>
</tr>
</tbody>
</table>
What is the drilling sample?

• A drilling sample is the foundation or building block upon which the definition of a mineralised deposit is made.

• A drilling sample is an investment!

• Choose the appropriate drilling method for the task!
What goes wrong?
RC Drilling
What goes wrong? RC Drilling

• Loss of fines which often contain the mineralisation
• Down hole contamination
• Contamination from the cyclone
• Contamination in the splitter
• Non-representative sampling
• Variable sample weights
• Loss of air pressure
What goes wrong? RC Drilling

- Use of water – wet samples
- Sample mix-up
- Inconsistent sample weights, both primary and secondary
- Over- and under-drilling of the hole
- Hole deviation
- Lack of down hole surveys
- Rig destroying hole collars
- Lack of attention by the geologist and/or field technician
- Equipment wear and damage
What goes wrong?
What goes wrong? Diamond drilling
What goes wrong? Diamond drilling

- Poor core recovery/core loss
- Poor RQD
- Flushing out fines in soft material
- Poor or insufficient downhole surveys
- Incorrect orientation of core in trays
- Inconsistent sampling of core in trays
- Incorrect marking of core trays
- Swelling of core in clay zones
- Inconsistent core cutting
- Inconsistent sampling of core
- Poor core photography
- Contamination from drilling fluids
- Over- and under- drilling
- Equipment wear and damage
What goes wrong?
Graphitic gneiss
How do we achieve and maintain quality?

Best Sample Practice for QAQC
JORC Code (2012) Table 1

• Section 1 Sampling Techniques and Data
• Sampling errors occur at each stage of the sampling process, and are additive
• The largest sampling errors occur at the Primary Sampling stage
• Quality control uses statistical tools to monitor contamination, accuracy, precision and bias

Quality Assurance put in place to prevent problems
Quality Control aim is to detect problems in the event they occur
Achieve and maintain quality (continued)...

- Publicly listed companies are required by the ASX to release data that is accompanied by an outline of sampling and QAQC procedures.
- Many financial institutions require an impartial audit of geological and analytical data as part of a “due diligence” process when raising funds for a project.
How do we achieve and maintain quality (continued...)

• Good QAQC programme is active
• Can be reviewed throughout the data collection process to enable corrective action if necessary
• Best practice procedures for drill hole samples include the use of standard, blank, duplicate and check samples to monitor for contamination, accuracy, precision and bias
• Be mindful of how these samples are utilised in the risk assessment process.
• Best sampling practice ensures that inevitable errors that occur in reality are minimised.
How do we achieve and maintain quality?

Most results fall into either of the middle two targets!

Accurate and Precise
Accurate but not Precise
Precise but not Accurate
Not Accurate or Precise

Quality control uses statistical tools to monitor contamination, accuracy, precision and bias.
How do we achieve and maintain quality (continued...)

- Knowledge leads to awareness
- Awareness leads to improvement
- The drilling sample is the investment

Having good control of data quality at the point of origin feeds into good decision making

The greatest opportunity to achieve and maintain quality of the drilling sample is at the time of drilling!
How do we achieve and maintain quality (continued...)

Best practice is often a compromise, but always aim high!
REMEMBER the GIGO Principle!

Garbage In, Garbage Out!

The quality of information coming out CANNOT be better than the quality of information that went in!

Your drilling sample is the foundation upon which many investments are made (and which can be lost!)
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