Comparison of traditional and novel on-line blast hole sampling in ore grade control

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This study:

- Compares traditional sampling methods used in ore grade control with a new on-line sampling and analysis method taking into consideration:
  - Sample representativeness
  - Precision
  - Sufficient analysis accuracy

- The field test was done in First Quantum Minerals’ (FQML) Kevitsa mine site in Sodankylä, Finland in co-operation with FQML, Atlas Copco and IMA Engineering Ltd in March 2011.
Problems in traditional blast hole sampling

• In practice, traditional sampling is:
  – imprecise
  – expensive
  – the analysis turnaround time is long

• Grade control based on samples, which are not representative, lead to:
  – ore losses
  – waste rock dilution
IMA Engineering Ltd has developed a novel sampler-analyser which:

- Collects continuously representative samples from blast hole cuttings
- Analyses them on-line while drilling with XRF method.
What is the essential difference between traditional and novel blast hole sampling?

How accurate is the novel sampling method?
TRADITIONAL SAMPLING & LABORATORY XRF ASSAYING

ONLY ONE HEAP SAMPLE

REAL BENCH

SUB-DRILL

HOLE GRADE AVERAGE 0,40 %

SAMPLER-ANALYZER SAMPLING & INSTANT XRF ASSAYING

Cu GRADE
0...0,1 %
0,1...0,3 %
0,3...0,6 %
0,6...99,9 %

REAL BENCH 0,13 %

SUB-DRILL

HOLE GRADE AVERAGE 0,23 %
# Sampling method summary

<table>
<thead>
<tr>
<th>Traditional methods vs. sampler-analyser</th>
<th>Diamond drill cores</th>
<th>Reverse circulation drilling</th>
<th>Blast hole drilling</th>
<th>Sampler-analyser</th>
</tr>
</thead>
<tbody>
<tr>
<td>DD</td>
<td>DD</td>
<td>RC</td>
<td>BH</td>
<td>PDSA</td>
</tr>
</tbody>
</table>

| Analysis Accuracy | Good | Good | Good | Good |
| Spatial Accuracy  | Good | Good | Bad  | Good |
| Analysing time    | Long | Long | Long | Short |
| Costs             | Expensive | Inexpensive | Inexpensive | Inexpensive |
# Test procedure

<table>
<thead>
<tr>
<th>Hole group 1</th>
<th>Hole group 2</th>
<th>Hole group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low grade Ni ore</td>
<td>Middle grade Ni ore</td>
<td>High grade Ni ore</td>
</tr>
<tr>
<td>PDSA</td>
<td>PDSA</td>
<td>PDSA</td>
</tr>
<tr>
<td>RC</td>
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</tbody>
</table>

PDSA = Percussion drilling sampler-analyser, Ø 165 mm  
RC = Reverse circulation drilling, Ø 130 mm  
DD = Diamond drilling, Ø 60 mm

The holes were located less than one meter distance from each other in each group.

PDSA: Sampling and analysis were carried out in one meter depth intervals.

Drill cuttings from every meter were collected and split using a riffle splitter for laboratory comparison assaying.
Results: Nickel and Copper
Comparison between PDSA, RC and DD *)

Ni

Cu

*) in three separate holes
Results: Nickel and Copper
Comparison between PDSA and laboratory analysis

Ni

Cu
Other applications: 3D mapping
Conclusions

• IMA novel sampler-analyser solves the fundamental sampling problem with practical solutions combining:
  ✓ Continuous sampling
  ✓ On-line XRF analysis

• Compared to DD or RC sampling methods the sampler-analyser is:
  ✓ Much faster
  ✓ Equally accurate method

• The use of sampler-analyser has positive impacts for:
  ✓ Economy, safety, and reconciliation

• Correct sampling and assaying saves:
  ✓ Energy and environment
Other available models:

Sampler-analysers integrated on the drilling rig or trailer versions:

- Blast hole sampler-analyser for rotary drill rigs (BSA)
- Underground drilling sampler-analyser (UGSA)
- Reverse circulation sampler-analyser for exploration drilling (RCSA)
Other available models:

Other On-Line XRF-analysis applications:

- Mobile lab for drill cores (Scanmobile and Remolog)
- Cross belt samplers and analysers
- Loader bucket scanner
- Sample Bag & Tag – application
- 3D blastfield modelling & digital loading map service
Thank you

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