Long-Term Monitoring Data from the Britannia Mine, BC

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Acknowledgments

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- Terry Johnson - Mine Manager
Presentation Outline

Geology
Historical Water Quality
Precipitates
Comparisons with Similar Sites
2002 Plug Test
Post Test Water Quality
Conclusions
Britannia Mine Geology - 2

Fig. 3. Longitudinal Section Britannia Mine.
Britannia Mine Geology – 3

Volcanic-associated massive sulphide deposit
- dacites > andesites
- clastics and tuffs

Ore minerals
- pyrite >> chalcopyrite
- sphalerite >> galena,
- no pyrrhotite.

Gangue minerals
- quartz, chlorite/biotite, anhydrite, siderite, barite

Jane Basin, looking SW
Historical Copper Data – 2200 Level

Copper (mg/L)

Dissolved Cu
Total Cu

'29  '39  '49  '59  '69  '79  '89  '99
2200 - Seasonal Flows and Copper Concentrations (1945 to 1952)
Historical Copper Data - 4100 Level

Dissolved Cu
Total Cu
## Britannia Mine Water Quality

### Averages, pre-2001 chemistry

<table>
<thead>
<tr>
<th>Stn.</th>
<th>pH</th>
<th>SO4</th>
<th>Al</th>
<th>Cd</th>
<th>Cu</th>
<th>Fe</th>
<th>Mn</th>
<th>Zn</th>
<th>Dist. from mine, km</th>
<th>Av. flow m3/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>2200</td>
<td>3.1</td>
<td>1088</td>
<td>42</td>
<td>0.19</td>
<td><strong>59</strong></td>
<td><strong>31</strong></td>
<td>3.6</td>
<td><strong>29</strong></td>
<td>1.5</td>
<td>2783</td>
</tr>
<tr>
<td>4100</td>
<td>3.8</td>
<td>1528</td>
<td>26</td>
<td>0.09</td>
<td><strong>18</strong></td>
<td><strong>4.5</strong></td>
<td>4.2</td>
<td><strong>21</strong></td>
<td>5</td>
<td>9704</td>
</tr>
</tbody>
</table>

* Concentrations are in mg/L

Data compilation courtesy BC MWLAP and SRK
Britannia Mine Geochemistry

- Differences between 4100 and 2200 due to dilution of some unknown mine water.

- pH > 3 (at least since 1972)
  - Fe and Al precipitation may act as buffer.
  - Lack of pyrrhotite

- During mining, with fresh air and fresh mineral surfaces, 2200 Cu was 1500+ mg/l.

Jane Creek before Dec ’01
Geochemistry of the 4150 Sludges

Whole rock:
- 57% Fe₂O₃
- 2% Al₂O₃
- 38% loss on ignition

ICP metals (ppm, dry wt)
- Cu – 4382,
- Zn – 360
- Cd – <0.8,
- Pb – 181
- Fe – 107,000

Iron hydroxide sludge, 4150 level
Britannia compared to others

<table>
<thead>
<tr>
<th>Tulsequah Chief:</th>
<th>Anyox:</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH 3.0</td>
<td>pH 2.8</td>
</tr>
<tr>
<td>Cu 33.5</td>
<td>Cu 2.3</td>
</tr>
<tr>
<td>Fe 34</td>
<td>Fe 275</td>
</tr>
<tr>
<td>Al 22</td>
<td>Al 48</td>
</tr>
<tr>
<td>Zn 63</td>
<td>Zn 5</td>
</tr>
<tr>
<td>SO$_4$ 997</td>
<td>SO$_4$ 3500</td>
</tr>
</tbody>
</table>

(after SRK Consulting, 1992)

(Environment Canada data to 2000)

* Concentrations in mg/L
Release of Water During 2002 Plug Test
4100 L
2700 L
4100
Portal
4100 Plug
Mineral Creek
Britannia Creek
Flooded Mine Workings
Howe Sound
Britannia Beach
#10 Shaft
Bluff
2200 L
Mine Workings Flooded during Plug Test
Victoria Shaft
Jane Basin
Flooded Mine Workings
2200 L
2700 L
4100 L
4100 Plug
4100 Portal
Howe Sound
Plug Tests

Water Level (m)

- April 25
- June 19
- Aug 16
- Draindown complete

- 13-Mar
- 10-Apr
- 08-May
- 05-Jun
- 03-Jul
- 31-Jul
- 28-Aug
- 25-Sep
- 23-Oct
Sulphate and Copper

Sulphate (mg/L)

Copper (mg/L)

Pre-Plug Average

Draindown complete
Comparison of Pre-Plug and Post-Plug Test Concentrations

SO4 (wt. avg) vs. SO4 (2003)

SO4 (wt. avg) vs. SO4 (2003)

pH (wt avg) vs. pH (2003)

Al, Al, Cu, Cu

Fe, Fe, Mn, Mn
Permanently Flooded Mine Workings

Bluff Mine Workings Flooded during Plug Test

Jane Basin

2200 Plug

Victoria Shaft

2200 L

2700 L

4100 L

Permanently Flooded Mine Workings
Conclusions

- Flooded mine water had lower pH and higher than average sulfate and metal concentrations compared to pre-plug test values, consistent with the leaching of stored acidic salts.

- Higher than average sulphate and metal concentrations persisted for 2 to 3 months following the test.

- Concentrations of sulphate, aluminum, copper and iron were below average 4 to 10 months after the test, indicating effects of flooding were relatively short duration.