B.5. Closure of the Tailings Impoundment at the Snip Mine

by

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CLOSURE OF THE TAILINGS IMPOUNDMENT AT THE SNIP MINE

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SNIP MINE

- Operated since 1991
- No road access (hovercraft/air)
- Cominco 1991-1996
- Prime Resources/Homestake 1996-present
- Mine Shutdown: May 1999

Closure: May 1999 to present

Geology

- Intrusion related gold-bearing quartz-carbonate veins
- Hosted in feldspathic greywackes, siltstones and mafic tuffs
- Sheared veins with alternating pyrite/calcite stringers
- Primary sulphide: pyrite
  (pyrrhotite, chalcopyrite, arsenopyrite, galena)
- Primary carbonate: calcite
  (ankerite, siderite)
SNIP MINE
Mining

- Underground mine (~1.3 M tonnes mined)
- Gold/concentrate shipped by hovercraft/air (~1 Moz Au)
- Coarse tailings backfilled to mine
- Fine tailings discharged to tailings impoundment
- Tailings impoundment located at the head of Monsoon and Sky Creeks

Snip Mine Tailings Impoundment - looking North towards the Iskut River
ARD/ML MONITORING PROGRAM

- Weekly composites of tailings collected between January 1992 and May 1998 (337 samples)
- Tailings beach samples collected annually (42 samples)
- Samples analysed for ABA parameters and ICP metals
- Monthly composites of tailings collected between January 1993 and March 1998 (63 samples)
- Monthly composites analysed for ICP metals only
- Petrographic examination of a tailings composite

ARD/ML MONITORING PROGRAM

Form of Neutralization Potential

Estimated using:
- modified Sobek NP
- total inorganic carbon (TIC)
- weak-acid leachable Ca, Mg, Fe, Al
- aqua regia ICP Ca+Mg
- petrographic examination

Calcite (CaCO₃) is the primary neutralizing mineral (magnesium carbonate, biotite*, chlorite and feldspars)

* identified using Reitveld-XRD
**ARD/ML MONITORING PROGRAM**

*Tailings ABA Characteristics*

Sulphide S = Total S

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<tbody>
<tr>
<td>Total S</td>
<td>4.3%</td>
<td>(2.8% to 5.8%)</td>
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<tr>
<td>MPA</td>
<td>133 kg CaCO$_3$/t</td>
<td>(89 to 182 kg CaCO$_3$/t)</td>
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<tr>
<td>NP</td>
<td>186 kg CaCO$_3$/t</td>
<td>(157 to 231 kg CaCO$_3$/t)</td>
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<tr>
<td>NP/AP</td>
<td>1.4</td>
<td>(1.0 to 2.3)</td>
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**Final Tailings Weekly Composite Samples**

Neutralization Potential (NP) vs Maximum Potential Acidity (MPA)

[Diagram showing the relationship between NP and MPA with different MPA values: NP/MPA = 4, NP/MPA = 2, NP/MPA = 1]
Final Tailings Weekly Composite Samples
NP/MPA vs Time

Mean = 1.4

SEM Photograph - Tailings

Cal - calcite
Py - pyrite
Ank - ankerite
Ab - albite
Po - pyrrhotite
Mc - microcline
Bt - biotite
Qz - quartz
Mag - magnetite
Cst - cassiterite
Rt - rutile
Ap - apatite
Ilm - ilmenite
KINETIC TESTING PROGRAM

- Humidity cells (1991)
  1 tailings and 3 ore samples
  10 weeks - No ARD generation

- Column tests (1994)
  Tailings and waste rock
  42 weeks - No ARD generation

- Humidity cell testwork (1998 to present)
  3 tailings cells
  2 waste rock cells (150 and 180 dumps)
  2 accelerated tailings cells (50% NP depletion)

- SEM-XRD analysis of 3 tailings cell samples
Tailings Humidity Cells

Sulphate

- Tailings 1
- Tailings 2
- Tailings 3

CuSO₄

Tailings Humidity Cells

Copper

- Tailings 1
- Tailings 2
- Tailings 3

Cu^{2+}
RESULTS AND INTERPRETATION

- Tailings are non-acid generating
- Waste rock (150+180 dumps) are non-acid generating, likely acid consuming
- Low metals leaching rates from all materials
- NP exhaustion estimated at 13 to 35 years in tailings
- Tailings sulphide 'burnout' near or before NP exhaustion
- 130 and 440 waste rock dumps potentially acid generating
SITE CONSIDERATIONS FOR CLOSURE

- Isolated Location
  Infrequent monitoring
  Difficult/expensive to access after Closure
- ARD Potential of Materials
  (tailings, waste rock)
- Physiography
  (Precipitation, seismic activity, etc.)
- Regulatory requirements
- Company requirements

TAILINGS CLOSURE Options

- Flooded Impoundment
  Minimum risk of ARD
  Increases risk of dyke failure
  Beavers
- Engineered Dry Cover
  Insufficient construction materials
  (> surface disturbance than mine)
- Thin Soil Cover / Partial Water Cover
  ‘As is’ solution - minimum reclamation
  Minimum contingencies

- Saturated Cover
TAILINGS CLOSURE
Saturated Cover

- Maintain water-saturated anoxic conditions with tailings
- Minimize water ponding on surface
- Water table maintained within waste rock cap above tailings
- Organic soil cover provides growth medium
- Final closure as meadow/wetland

TAILINGS CLOSURE
Saturated Cover

- Regrading of tailings to 0.15% slope towards Sky Creek
- 130 and 440 waste rock placed deep in tailings
- Cover with 50 cm of NAG waste rock
  150 and 180 waste dumps
- Cover with 15 cm of soil
till + organic material
TAILINGS CLOSURE
Saturated Cover

- Construction of Spillway to Sky Creek
  french drain to retard beaver dam construction
  spillway designed for dam construction if flooding
  required
- Impoundment cover allowed to revegetate naturally
- Ongoing monitoring (field and lab)

Tailings Impoundment Cross Sections