Geology of the El Toqui Zn-Au Skarn district, Aysen Region, Chile

Steven Bussey – Western Mining Services
Alejandro Kakarieka – IAMGOLD Corporation
Larry Meinert – Smith College
Geology of the El Toqui Zn-Au Skarn district

- Introduction
- Regional Geologic Setting
- District Geology
- Porvenir and Aserradero Orebodies
- Zonation
- Geochronology
- Summary
Introduction - Location

1300 km south of Santiago in the Aysen Region of southern Chile, South America
## Introduction – Exploration History

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1970</td>
<td>Discovery</td>
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<tr>
<td>1974</td>
<td>Metallgesellschaft AG</td>
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<td>1983</td>
<td>El Toqui Start-Up</td>
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<td>1987</td>
<td>Lac Minerals</td>
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<td>1991</td>
<td>Doña Rosa orebody discovery</td>
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<td>1994</td>
<td>Barrick</td>
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<td>1997</td>
<td>Breakwater Resources</td>
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<td>2001</td>
<td>Aserradero Gold Skarn discovery</td>
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<td>2006</td>
<td>Porvenir discovery</td>
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<tr>
<td>2007</td>
<td>Mina Profunda Gold Skarn discovery</td>
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</tbody>
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District Geology - Stratigraphy

- Intrusive Rocks
- Upper Divisadero Gp
- Lower Divisadero Gp
- Katterfeld Fm
- Ibañez Gp
- San Antonio Rhyolite
- Altazor andesite
- Gemelos andesite
- Volcanic sandstone
- Upper manto
- Banded tuff
- Pumice lapilli tuff layer
- Main manto
- Pumice lapilli tuff layer
- Pumice lapilli tuff layer
- Calcareous sandstone

10 meters
District Geology – Host Rock Sequence
District Geology – Main Manto limestone

Oyster shell coquina
District Geology – Geologic Map

Orebody, projected to surface

1. Zuñiga-Antolin
2. Concordia
3. Mallines
4. Estatuas
5. San Antonio
6. Mallin-Monica
7. Doña Rosa
8. Mina Profunda
9. Aserradero
10. Porvenir

Stream
Fault
Inferred fault
Relative motion: U - up
D - down

Stratified Rocks
- Quaternary cover
- Upper Divisadero
- Lower Divisadero
- Katterfeld Fm
- Toqui Fm
- Ibañez Gp

Intrusive Rocks
- Altazor andesite
- San Antonio rhyolite
- Gemelos andesite
District Geology – Main Manto Alteration

Faults in Main Manto
- Orebody
- San Antonio rhyolite

Main Manto alteration:
- garnet > 25%
- pyroxene > garnet
- amphibole > pyroxene
- epidote > pyroxene
- chlorite + sericite
- unaltered Main Manto

1 Km
Porvenir and Aserradero - Geology
Porvenir and Aserradero - Geology
Porvenir and Aserradero - Alteration
blue-green pyroxene
red-brown garnet
PDT-66-334m

Sphalerite

Arsenopyrite

Pyroxene
Porvenir and Aserradero - Zn
Massive Sphalerite

Apy

Manto Principal PDT-55

307.10m
amphibole > pyroxene

Shells replaced by sphalerite

pyroxene > amphibole
Porvenir and Aserradero – Au
Aserradero Ore

1cm

amphibole, arsenopyrite, sphalerite
District Geology – Alteration at Depth

Porphyry-style mineralization encountered at depth

- Faults in Main Manto
- Orebody
- San Antonio rhyolite
- Main Manto alteration
  - garnet > 25%
  - pyroxene > garnet
  - amphibole > pyroxene
  - epidote > pyroxene
  - chlorite + sericite
  - unaltered Main Manto

1 Km
District Geology – Alteration at Depth

654.85m
- Cpx-Py vein
- Marked silicious halo around Py - Chl veins

688.70m
- Chloritic halo
- Sericitic halo
- Sill-Py vein with double alteration halo

Fm Ibañez DEL-05

ATZ-3-973

Pozo DEL-05
1] 16.30 m

Mo
District Geology – Zonation

Fe-poor sphalerite
Pyrite-only
Pb & Ag-rich
As-poor

No skarn minerals
Chlorite, sericite,
rhodochrosite
Local silicification

Fe-rich sphalerite
Pyrrhotite + pyrite
Magnetite locally
Pb & Ag-poor
As-rich
Late gold event

Garnet, pyroxene
skarn with a zone
of late amphibole

Lower temperature
of formation

Higher temperature
of formation

1 Km
District Geology - Geochronology

1 – Palacios et al., 1996
2 – Townley and Palacios, 1999

Ibañez Fm dacite tuff from Toqui drill hole
Altazor: deep qtz-py-mo vnl
t C°Elefantes: deep qtz-py-cpy-mo vnl
District Geology – Mineralization Timing

**Possibility 1**

- North Toqui
  - Carbonate-replacement and veins 117 Ma
  - San Antonio rhyolite sills 120 Ma
  - Porphyry-style stockworks 118-120 Ma

- South Toqui
  - Zinc skarn and Au-Co actinolite 111-109 Ma
  - Porvenir dacite sill 113 Ma

**Possibility 2**

- North and South Toqui
  - ~117 Ma
  - San Antonio rhyolite sills 120 Ma
  - Porphyry-style stockworks 118-120 Ma

- South Toqui
  - Au-Co actinolite 111-109 Ma
  - Porvenir dacite sill 113 Ma
  - Au-Co+actinolite
Conclusions

• The district is zoned from higher temperatures in the south to cooler temperatures in the north
• Amphibole-gold overprints this zonation in the south
• Two mineralization events are recognized: 120-117 Ma and 111-109 Ma
• The 120-117 Ma event is associated with compressive deformation and emplacement of rhyolite sills
• The 111-109 Ma event is associated with dacite sill emplacement at 113 Ma
• Gold mineralization occurred during the 111-109 Ma event
Thank You