The Josemaría and Los Helados porphyry Cu-Au deposits: The timing of porphyry emplacement, uplift, and erosion in the El Potro (Vicuña) region of Chile and Argentina

Fionnuala Devine, Martin I. Sanguinetti, Bob Carmichael, Juan Arrieta

SEG 2019, Santiago, Chile
Location within the Miocene porphyry belt

Major mineral deposits (latest Oligocene - Miocene)

- ▲ HS epithermal Au ± Ag
- ■ Porphyry Au
- □ Porphyry Cu-Au
- ● Porphyry Cu-Mo

Quaternary volcanoes (the modern arc)
Depth contours on present-day Wadati-Benioff zone (Culkin and Ibsucks, 1992)
Major deposits discovered as of year 2000

Major mineral deposits (latest Oligocene - Miocene)

- ▲ HS epithermal Au ± Ag
- ◇ Porphyry Au
- ■ Porphyry Cu-Au
- ♦ Porphyry Cu-Mo

South America

Quaternary volcanoes (the modern arc)
Depth contours on present-day Wadati-Benioff zone (Cuhill and Isaacks, 1992)
High-altitude, moderate terrain in Argentina

Remote, self-sufficient camps in the early days

Limited road access prior to exploration of recent years

Rugged terrain on the west-facing Chilean side
Vicuña region grassroots discoveries in the early 2000’s and onwards

Major mineral deposits (latest Oligocene - Miocene)
- ▲ HS epithermal Au ± Ag
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- ▲ Porphyry Cu-Au
- ■ Porphyry Cu-Mo

Quaternary volcanoes (the modern arc)
Depth contours on present-day Wadati-Benioff zone (Cuhill and Isacks, 1992)


Filo del Sol (2000) High-sulphidation Ag-Au-Cu subjacent porphyry system currently being explored
Maricunga to El Indio - A continuous magmatic belt

Major mineral deposits (latest Oligocene - Miocene)

18 - 5 Ma
- HS epithermal Au ± Ag
- Porphyry Au
- Porphyry Cu-Au
- Porphyry Cu-Mo

25 - 20 Ma
- HS epithermal Au ± Ag
- Porphyry Au
- Porphyry Cu-Au

Mid - late Miocene
- Volcanic and sedimentary rocks

latest Oligocene - early Miocene
- Volcanic and sedimentary rocks

Age data and distribution of volcanic and sedimentary rocks compiled from numerous sources, listed in Sillitoe et al. (2019)
Tectonic shortening (Miocene) – in response to slab shallowing

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(latest Oligocene - Miocene)

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latest Oligocene - early Miocene

Volcanic and sedimentary rocks

El Potro fault location and concept after Mpodozis and Kay, 2003
The Vicuña region

After:
Sanguinetti, 2006
Mpodozis and Kay, 2003
The Los Helados Fault: > 800 m westward vertical throw (reverse)

- Permian rhyolitic volcanic rocks
- Andesitic volcanic rocks (Eocene? Late Oligocene?)
- Red bed sedimentary rocks (Eocene? Late Oligocene?)

View South

East

Los Helados fault

West
The Vicuña region

Mineralization of two ages

Mid-Miocene
~16-13 Ma

Latest Oligocene
~25-24 Ma
Probable Reserves*:
- 6.5 billion pounds copper
- 6.5 million ounces gold
- 29 million ounces silver

*Grassroots discovery* by NGEx Resources in 2004

- Aster anomaly follow-up with surface geochemistry
- First drill hole (2004): 280 metres at 0.61% Cu and 0.51 g/t Au
- Drilling from 2004 – 2018: 71,720 metres
- Positive 2018 PFS
- 2019 company name change
- Project now 100% owned by Josemaría Resources TSX: JOSE

*A National Instrument 43-101 – Standards of Disclosure for Mineral Projects (“NI 43-101”) Technical Report, entitled “43-101 Technical Report, Pre-Feasibility Study for the Josemaría Copper-Gold Project, San Juan Province Argentina”, dated December 19, 2018, that summarizes the results of the PFS and incorporates the initial mineral reserve statement for Josemaría is available on SEDAR and on the Company’s website (the “Technical Report”). For readers to fully understand the information in this presentation, they should read the Technical Report in its entirety, including all qualifications, assumptions and exclusions that relate to the PFS. The Technical Report is intended to be read as a whole, and sections should not be read or relied upon out of context.
Porphyry Cu-Au, San Juan, Argentina

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A future open pit mine

- Topography favourable for open pit mining – low strip ratio
- Standard crush-grind-float processing
- Local geography with room for mine development

Orebody limit at > 0.3 Cu equiv. %

<table>
<thead>
<tr>
<th>Mineral Reserve 2018 PFS</th>
<th>Million tonnes</th>
<th>Cu (%)</th>
<th>Au (g/t)</th>
<th>Ag (g/t)</th>
<th>CuEq (%)</th>
<th>Cu (billion lbs)</th>
<th>Au (million oz)</th>
<th>Ag (million oz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proven</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Probable</td>
<td>1,008</td>
<td>0.29</td>
<td>0.21</td>
<td>0.92</td>
<td>0.41</td>
<td>6.5</td>
<td>6.5</td>
<td>28.8</td>
</tr>
<tr>
<td>Total Proven and Probable</td>
<td>1,008</td>
<td>0.29</td>
<td>0.21</td>
<td>0.92</td>
<td>0.41</td>
<td>6.5</td>
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<td>28.8</td>
</tr>
</tbody>
</table>

Josemaría

High-grade near surface, clean concentrate

Long section along centre of deposit

Josemaría

N – NE trend to hypogene and supergene mineralization

A northward trend within the deposit includes:

- Premineral lithological contact/structure that localized porphyry emplacement
- Shallow supergene-enriched Cu zone
- Post-mineral normal faults
- A deeper, focused supergene Cu zone
Josemaría  
Geologic section, southern (upper) part of the deposit  

View North  

Modified from:  
Sillitoe, et al. (2019)  
Geology of the Josemaría Porphyry Copper-Gold Deposit, Argentina: Formation, Exhumation, and Burial in Two Million Years; Economic Geology
Josemaría

Porphyry formation, exhumation, and burial in 2 m.y.

Modified from:
Sillitoe, et al. (2019) Geology of the Josemaría Porphyry Copper-Gold Deposit, Argentina: Formation, Exhumation, and Burial in Two Million Years; Economic Geology
Josemaría

Similar prospects along trend to the north

Ages from Sillitoe et al. (2019), Perelló et al. (2003), Yoshie et al. (2015), NGEx internal data
Late Oligocene-Early Miocene Mineralization

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Compilation after Sillitoe et al. (2019) and references therein
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A grassroots discovery by NGEx Resources in 2008
Los Helados Porphyry Cu-Au Chile

A grassroots discovery by NGEx Resources in 2008

Joint Exploration Agreement
63% NGEx Minerals
37% Pan Pacific Copper Co.
The property was staked in 2004.

Following up on recognition of a prospective alteration zone identified with Aster spectral mapping.
Los Helados  Permian – Triassic host rocks

VIEW SOUTH

East

Granite (Permian)

Dioritic - tonalitic intrusive complex (Triassic)

800 m

West

Granite (Permian)
Los Helados

Permian – Triassic host rocks
- Increasing intensity of sericitic alteration with incipient breccia at lowest elevation.
- Targeting supported by IP and soil geochemistry
- 2006: First RC hole with 290 metres at 0.23% Cu and 0.23 g/t Au
- 2007/08: First diamond drill hole - LHDH01
- Size of the system recognized with hole LHDH16 in 2010/11; LHDH17 with **1,090 metres @ 0.51% Cu and 0.26 g/t Au**
Los Helados

Mineral resource estimate

**Indicated Resource**
* 17.6 billion lbs Cu
* 10.7 million oz Au

**Inferred Resource**
* 5.8 billion lbs Cu
* 2.7 million oz Au

Drilling to date (2006 – 2015):
72,293 metres in 92 holes

For details on data verification, sample, analytical and testing results and the key assumptions, parameters and methods used to estimate mineral resources in respect of the Los Helados property, refer to the technical report entitled "Technical Report on the Los Helados Porphyry Copper-Gold Deposit Chile" dated August 6, 2019 with an effective date of April 26, 2019. www.sedar.com.
Los Helados

Large high-grade core zone

For details on data verification, sample, analytical and testing results and the key assumptions, parameters and methods used to estimate mineral resources in respect of the Los Helados property, refer to the technical report entitled "Technical Report on the Los Helados Porphyry Copper-Gold Deposit Chile" August 6, 2019 with an effective date of April 26, 2019. (www.sedar.com).

* A CuEq grade was calculated using US$3.00/lb Cu, US$1,300/oz Au and US$23/oz Ag, and includes a provision for selling costs and metallurgical recoveries.

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Los Helados

High-grade sulphide-cemented breccias

Modified after:
A. Guitart, MSc. (in prep)
Los Helados

High-grade sulphide-cemented breccias

Modified after: A. Guitart, MSc. (in prep)

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Description of the mineral resource block model found in: "Technical Report on the Los Helados Porphyry Copper-Gold Deposit Chile" dated August 6, 2019 with an effective date of April 26, 2019, available on SEDAR and on the Company’s website.
This exploration team has found* 17 million tonnes copper 29 million oz gold 354 million oz silver and identified a new mineral district over the past 15 years.

These discoveries came out of a regional exploration program that identified numerous targets, which still require follow-up exploration.

The first discoveries came quickly, but that does not necessarily mean the best or biggest have been found!

*Combined mineral resource estimates for Josemaría, Los Helados, and Filo del Sol