

**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

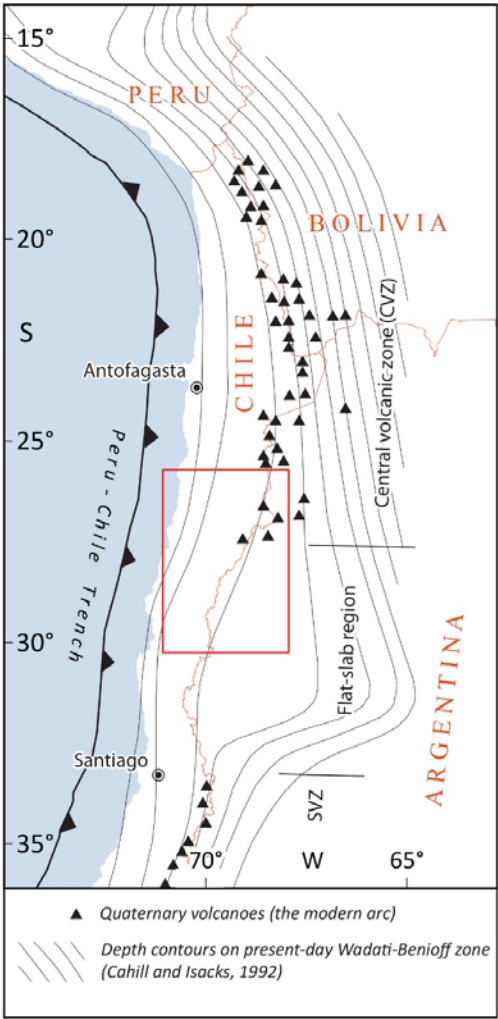
Fionnuala Devine, Martin I. Sanguinetti, Bob Carmichael, Juan Arrieta



SEG 2019, Santiago, Chile

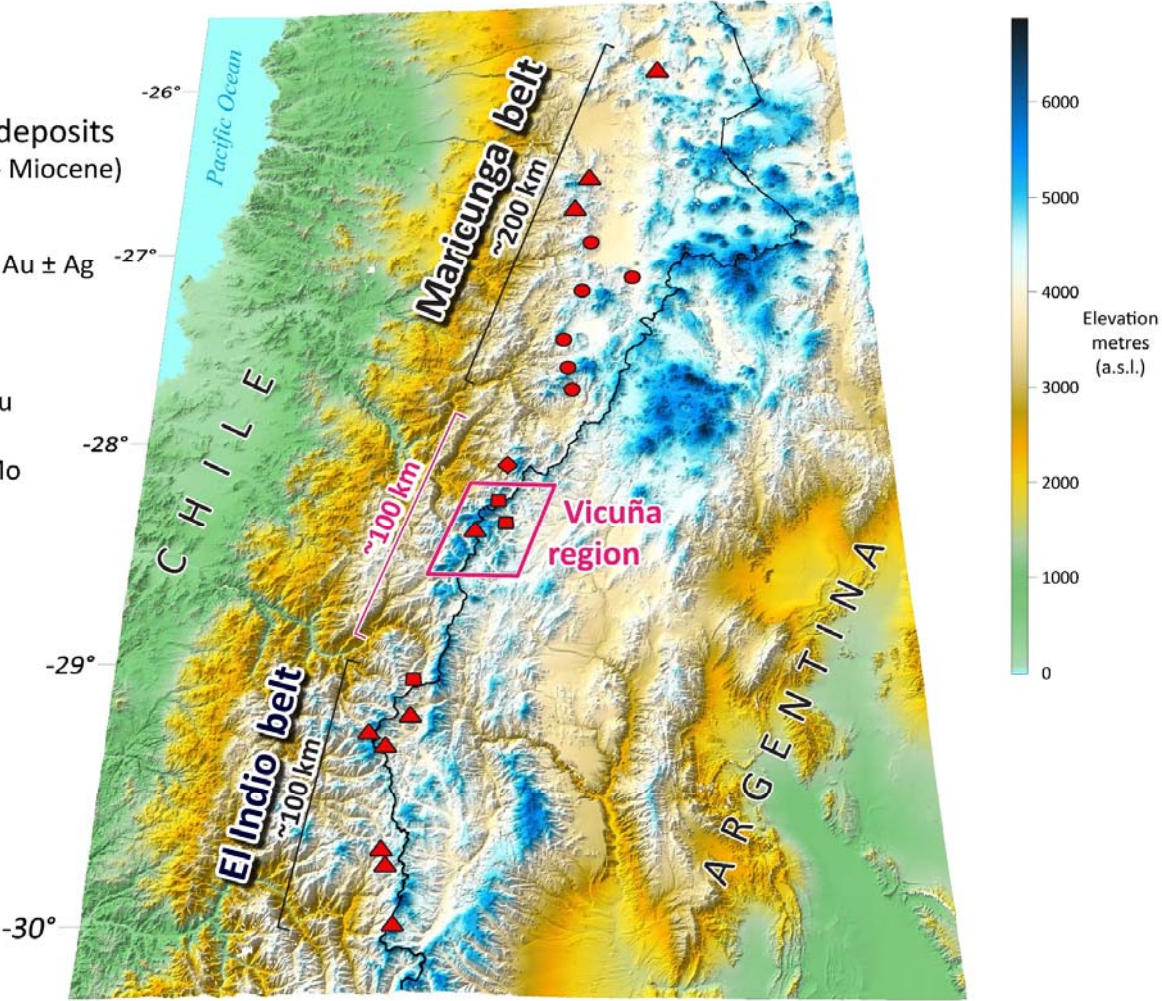


# Location within the Miocene porphyry belt

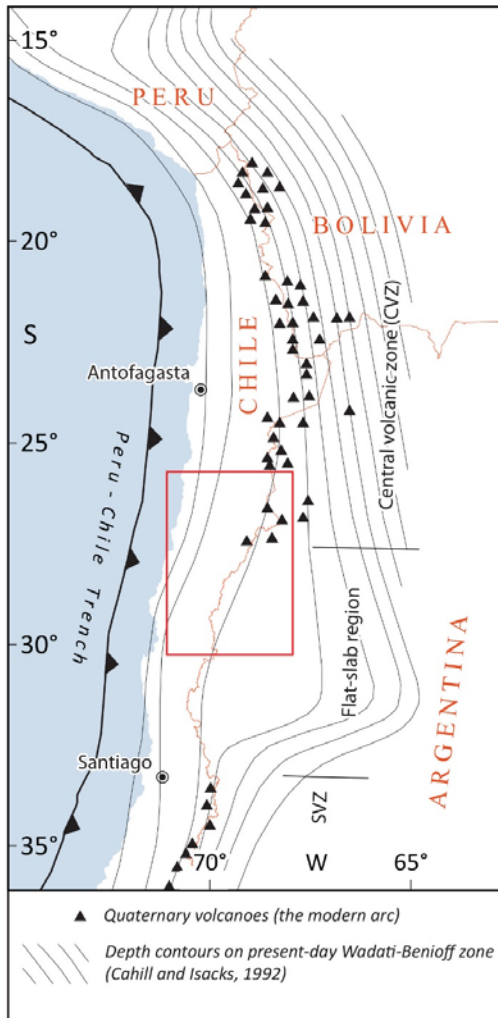


## Major mineral deposits (latest Oligocene - Miocene)

- ▲ HS epithermal Au ± Ag
- Porphyry Au
- Porphyry Cu-Au
- ◆ Porphyry Cu-Mo

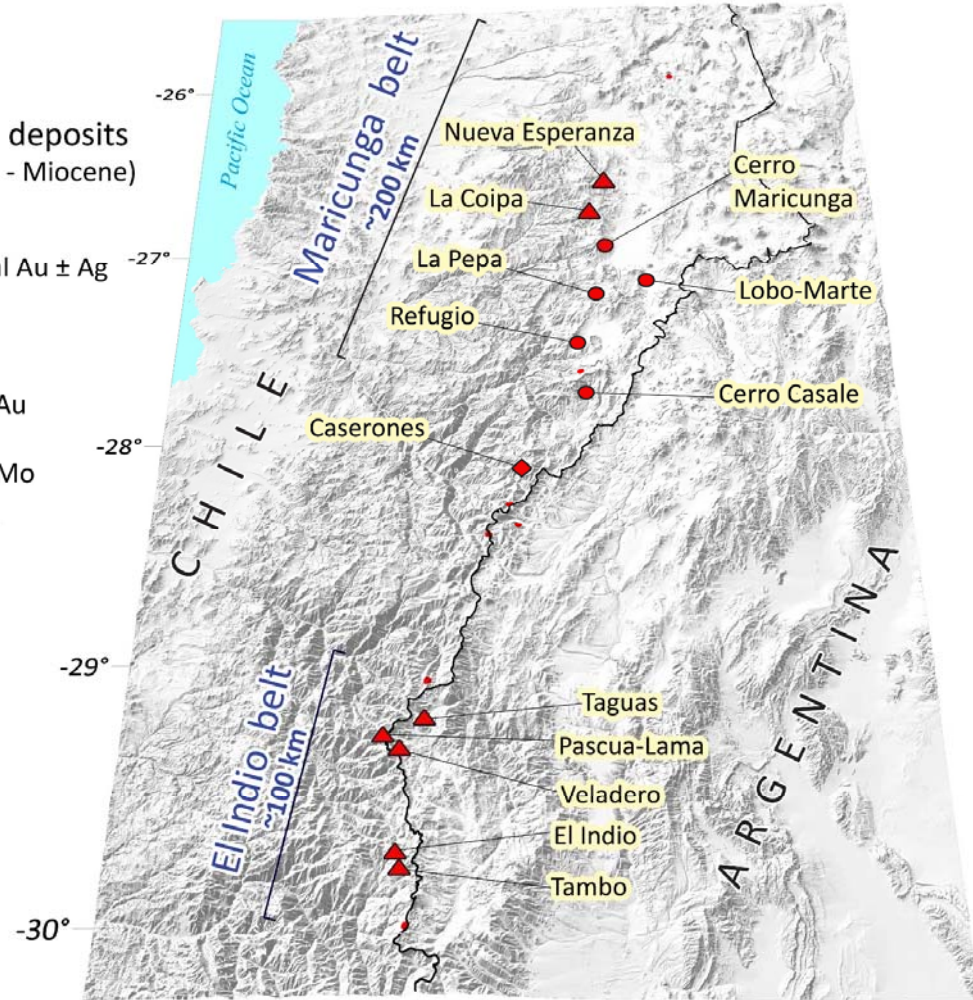


# Major deposits discovered as of year 2000



## Major mineral deposits (latest Oligocene - Miocene)

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High-altitude, moderate terrain in Argentina



Rugged terrain on the west-facing Chilean side

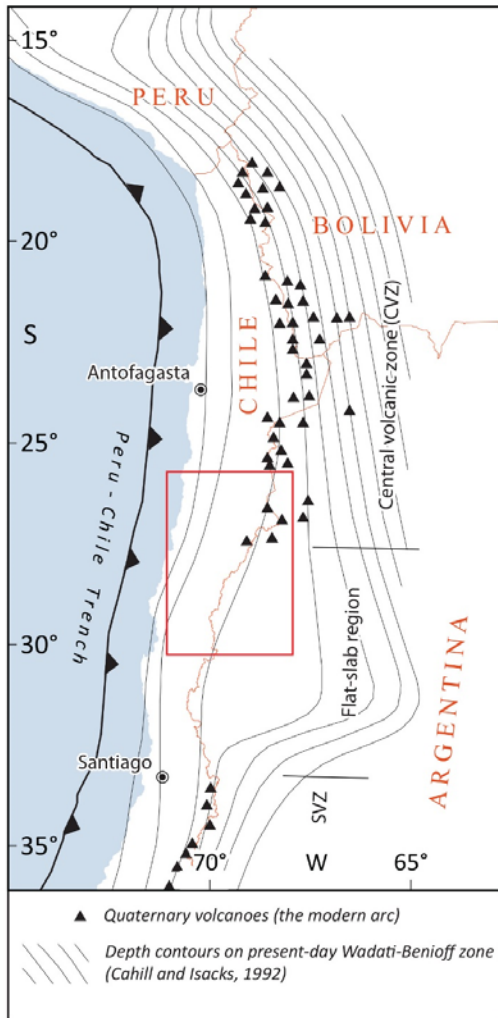


Remote, self-sufficient camps in the early days



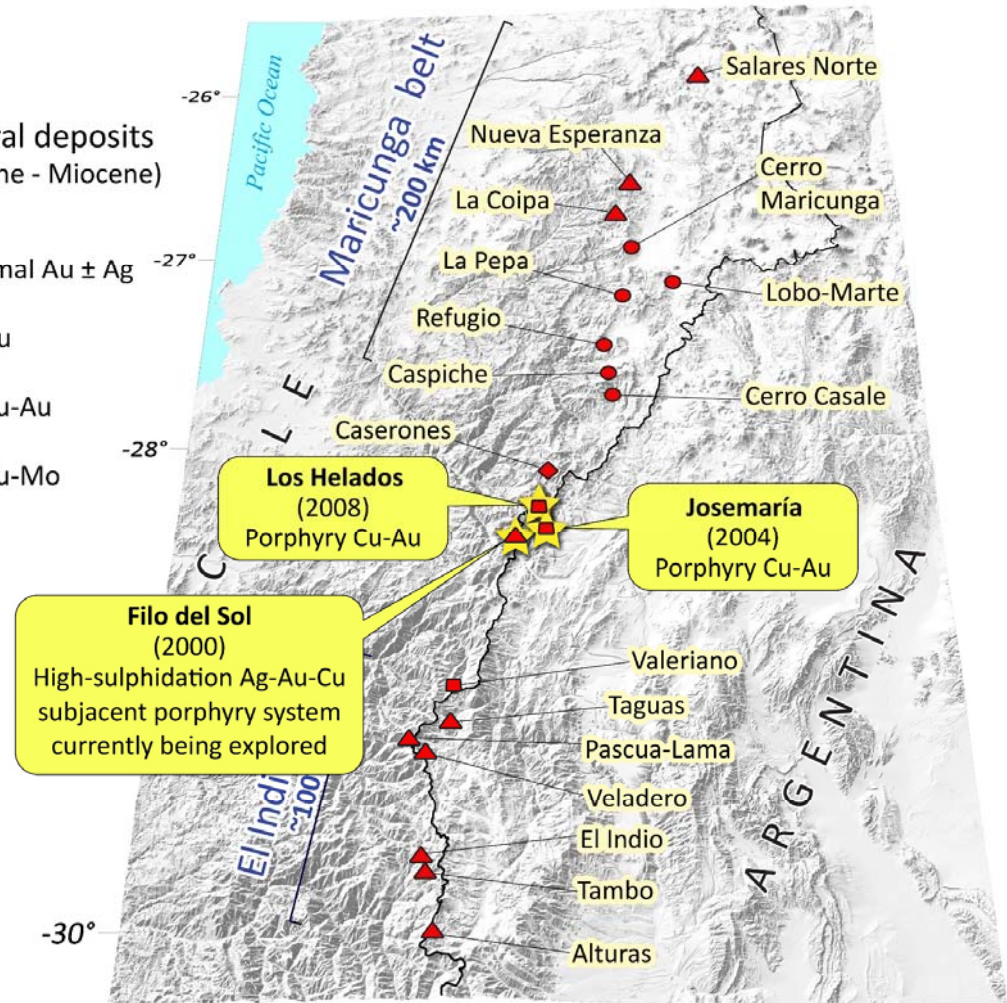
Limited road access prior to exploration of recent years

# 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-Mo



## 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**

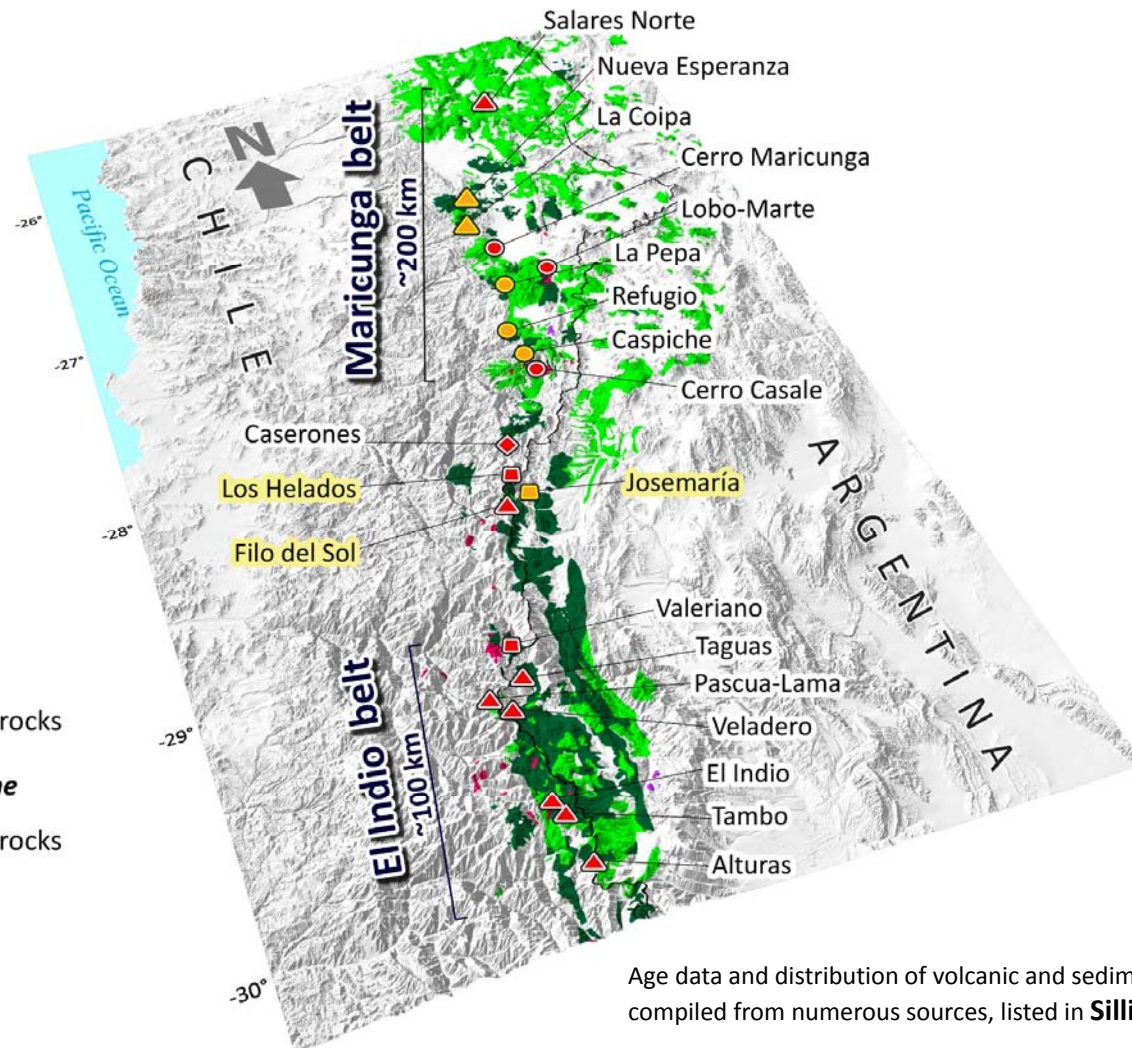
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**Mid - late Miocene**

■ 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

Major mineral deposits  
(latest Oligocene - Miocene)

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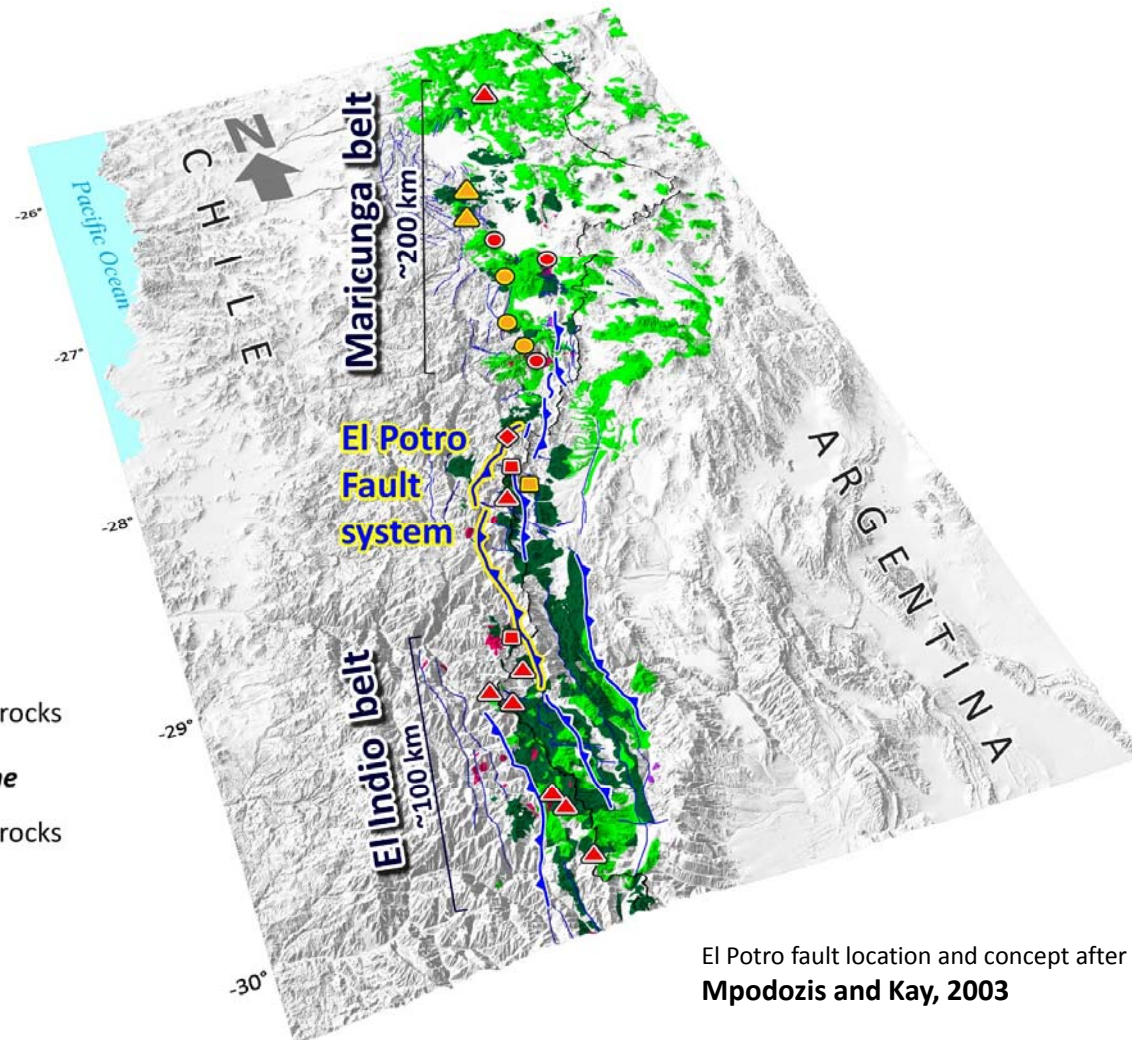
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### Mid - late Miocene

■ Volcanic and sedimentary rocks

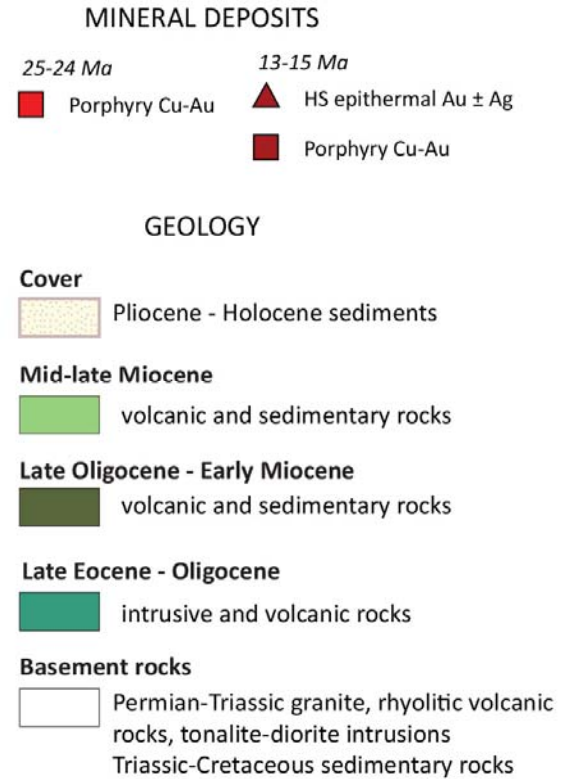
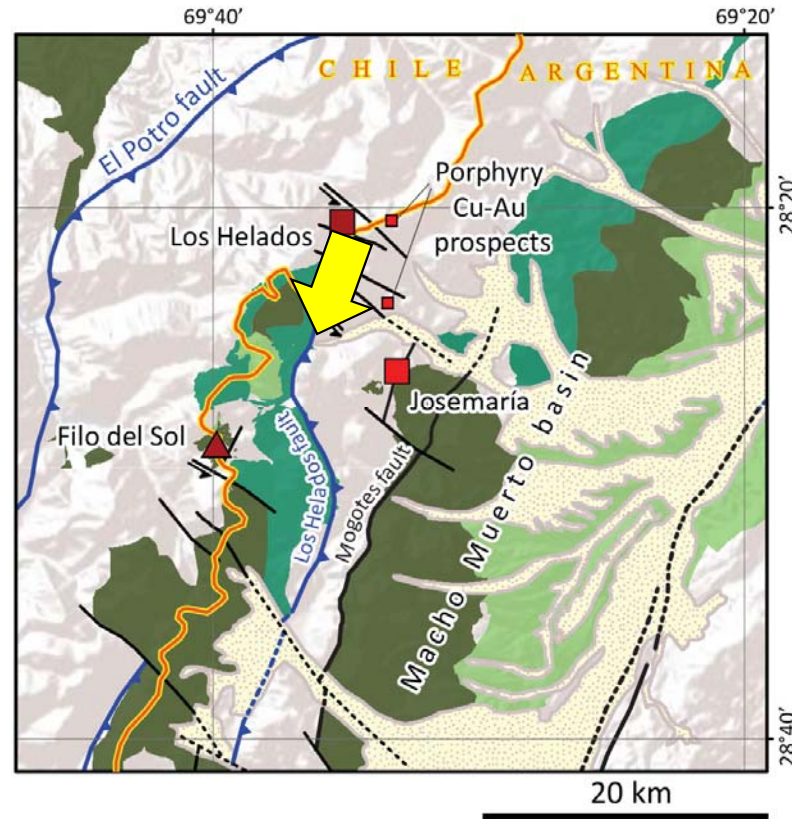
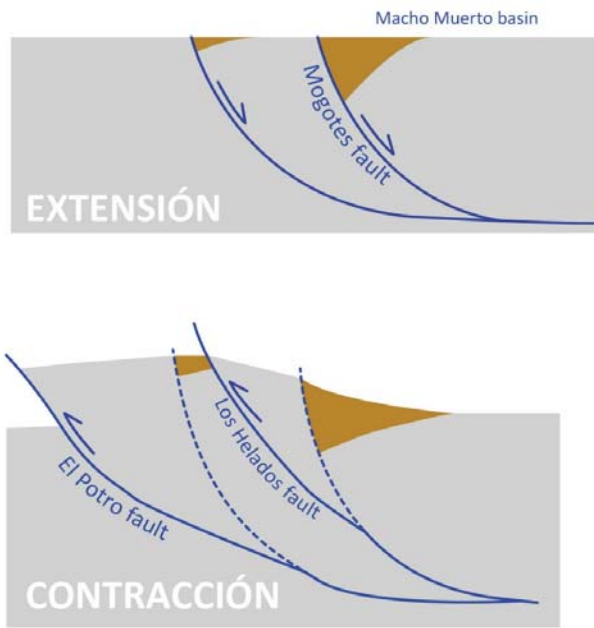
### latest Oligocene - early Miocene

■ Volcanic and sedimentary rocks



El Potro fault location and concept after  
**Mpodozis and Kay, 2003**

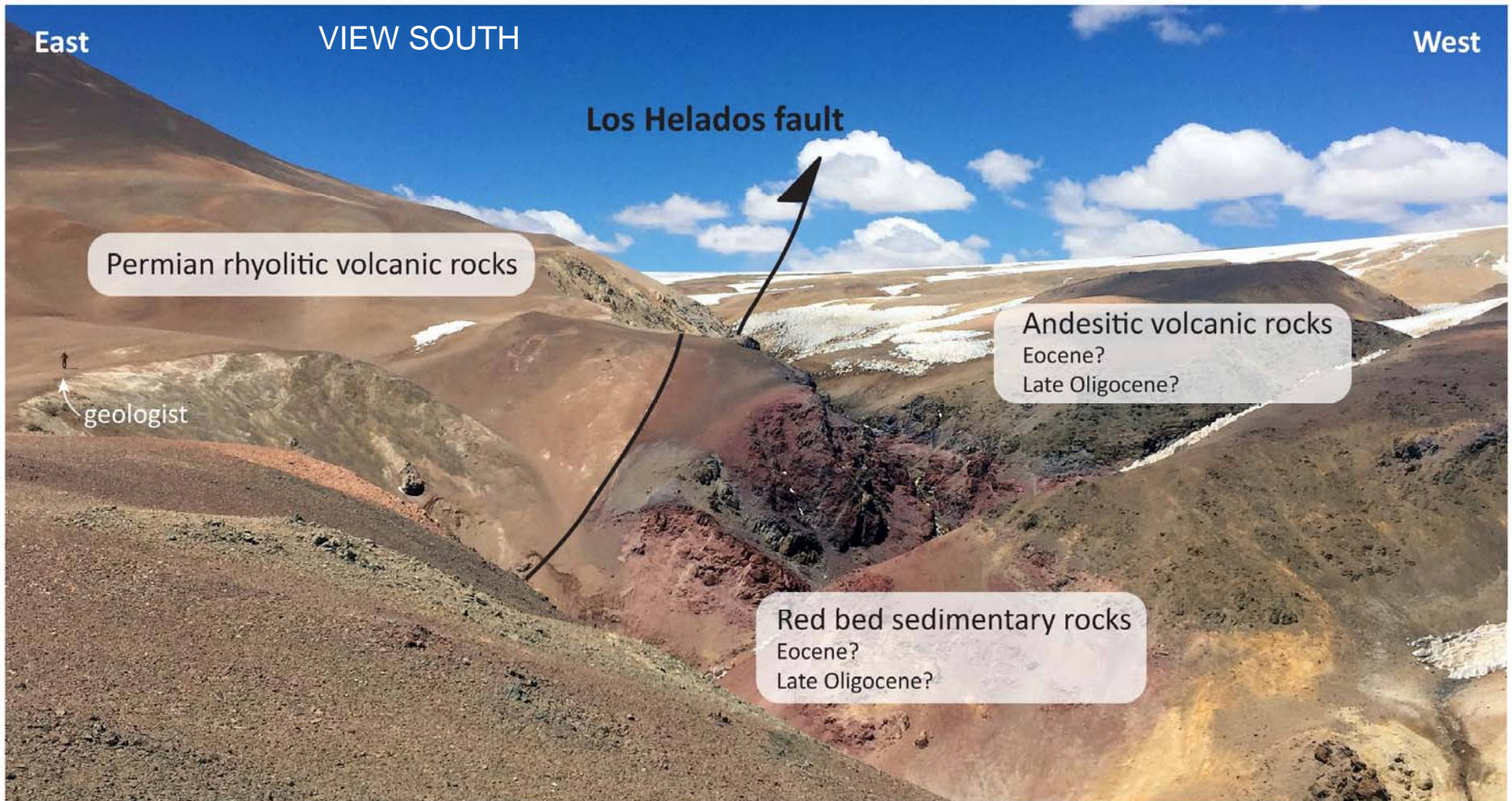
# The Vicuña region



After:  
 Sanguinetti, 2006  
 Mpodozis and Kay, 2003



## The Los Helados Fault : > 800 m westward vertical throw (reverse)

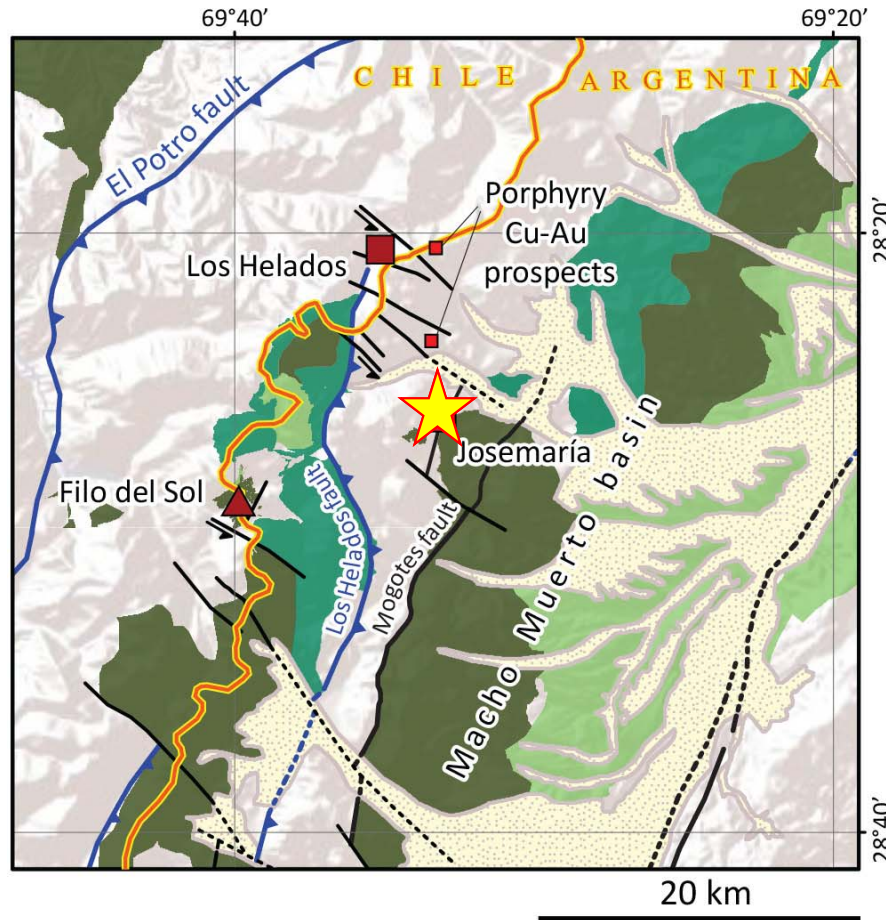


# The Vicuña region

Mineralization of two ages

**Mid-Miocene**  
~16-13 Ma

**Latest Oligocene**  
~25-24 Ma



## MINERAL DEPOSITS

25-24 Ma

■ Porphyry Cu-Au

13-15 Ma

▲ HS epithermal Au ± Ag

■ Porphyry Cu-Au

## GEOLOGY

### Cover

■ Pliocene - Holocene sediments

### Mid-late Miocene

■ volcanic and sedimentary rocks

### Late Oligocene - Early Miocene

■ volcanic and sedimentary rocks

### Late Eocene - Oligocene

■ intrusive and volcanic rocks

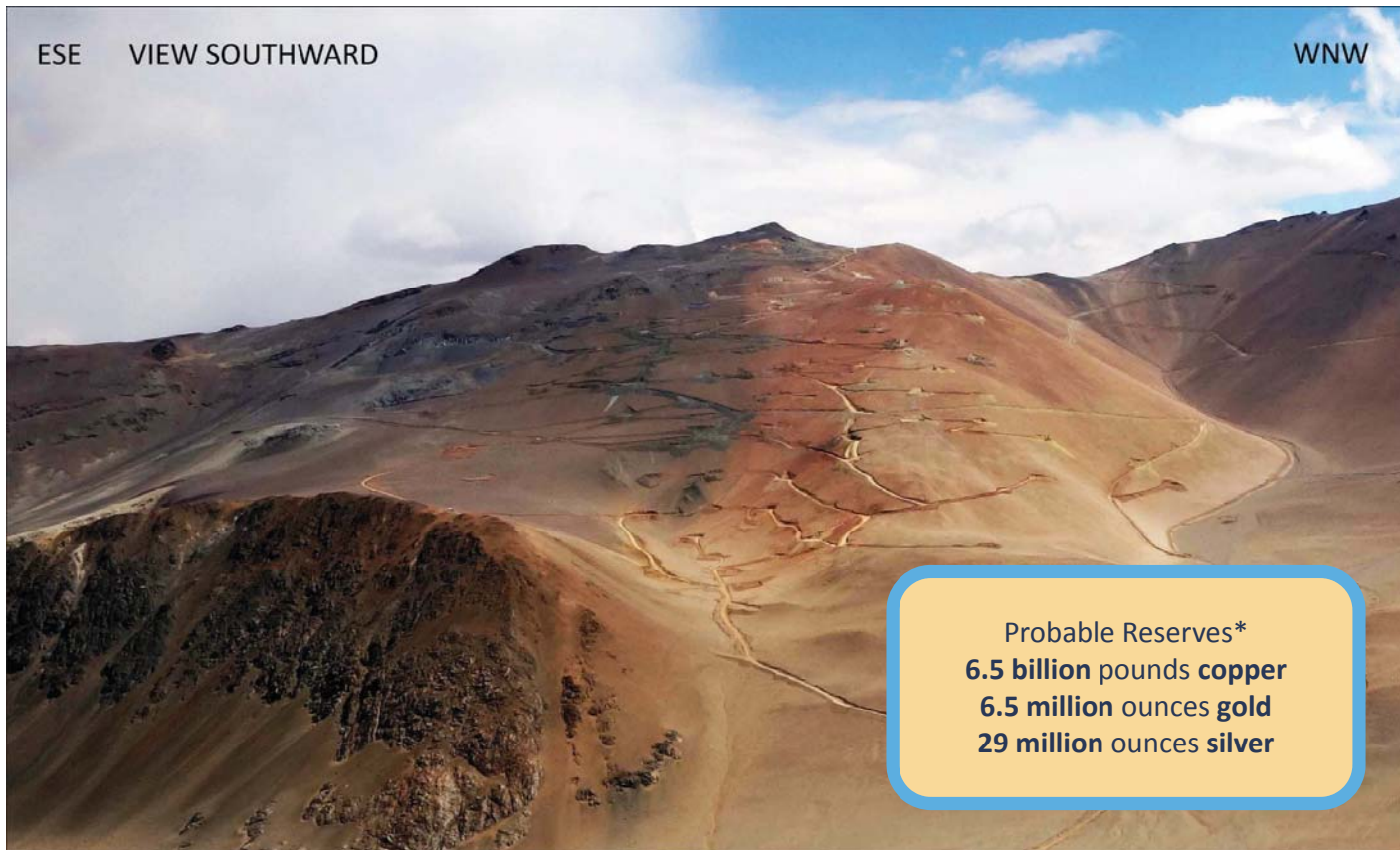
### Basement rocks

■ Permian-Triassic granite, rhyolitic volcanic rocks, tonalite-diorite intrusions  
■ Triassic-Cretaceous sedimentary rocks

# Josemaría

## Porphyry Cu-Au

## San Juan, Argentina



Probable Reserves\*  
6.5 billion pounds copper  
6.5 million ounces gold  
29 million ounces silver

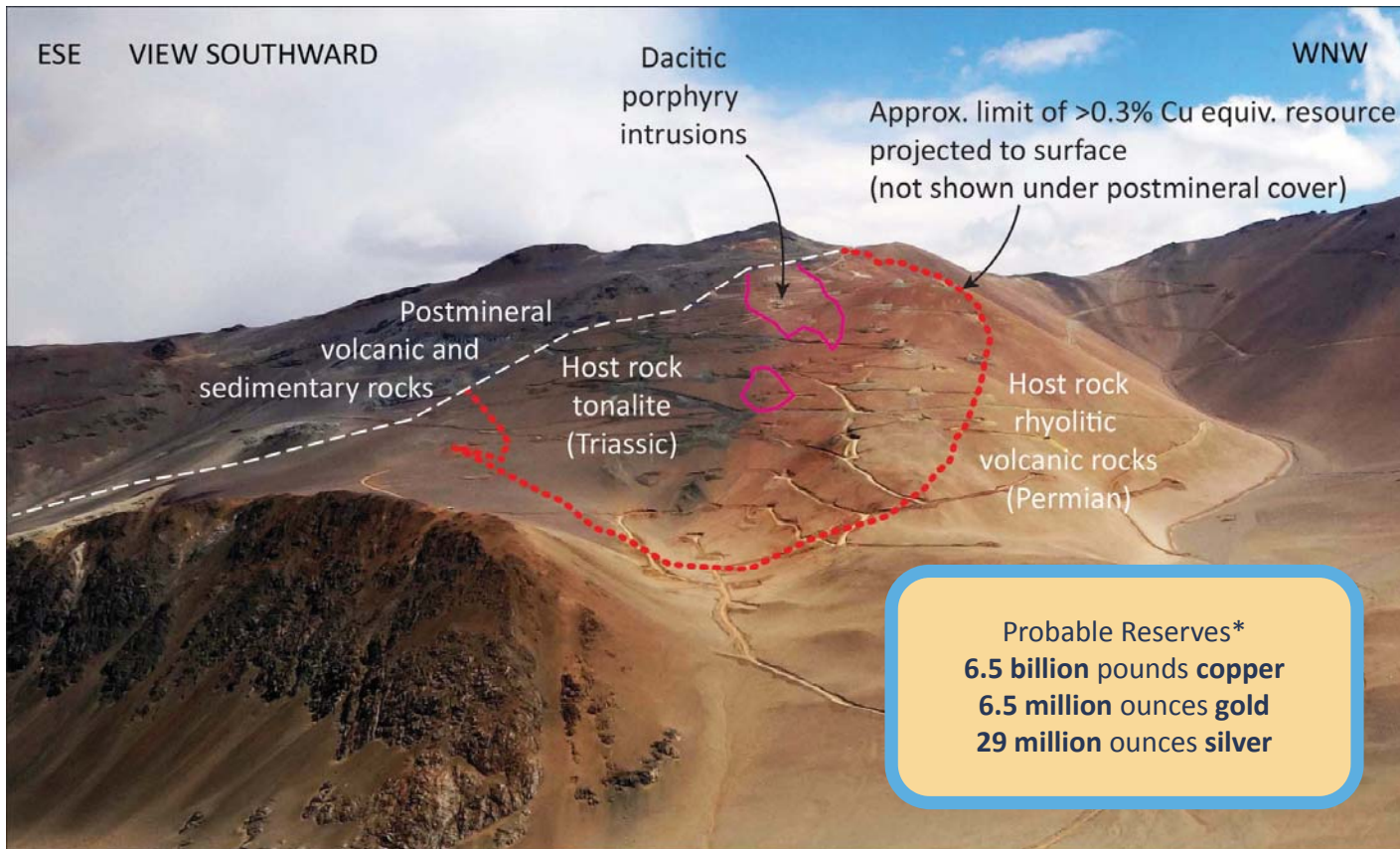
- **Grassroots discovery** by NGEEx Resources in 2004
- Aster anomaly follow-up with surface geochemistry
- First drill hole (2004): 280 metres at 0.61% Cu and 0.51 g/t Au
- Drilling from 2004 – 2018: 71,720 metres
- Positive 2018 PFS
- 2019 company name change
- Project now 100% owned by **Josemaría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

# Josemaría

## Porphyry Cu-Au

## San Juan, Argentina

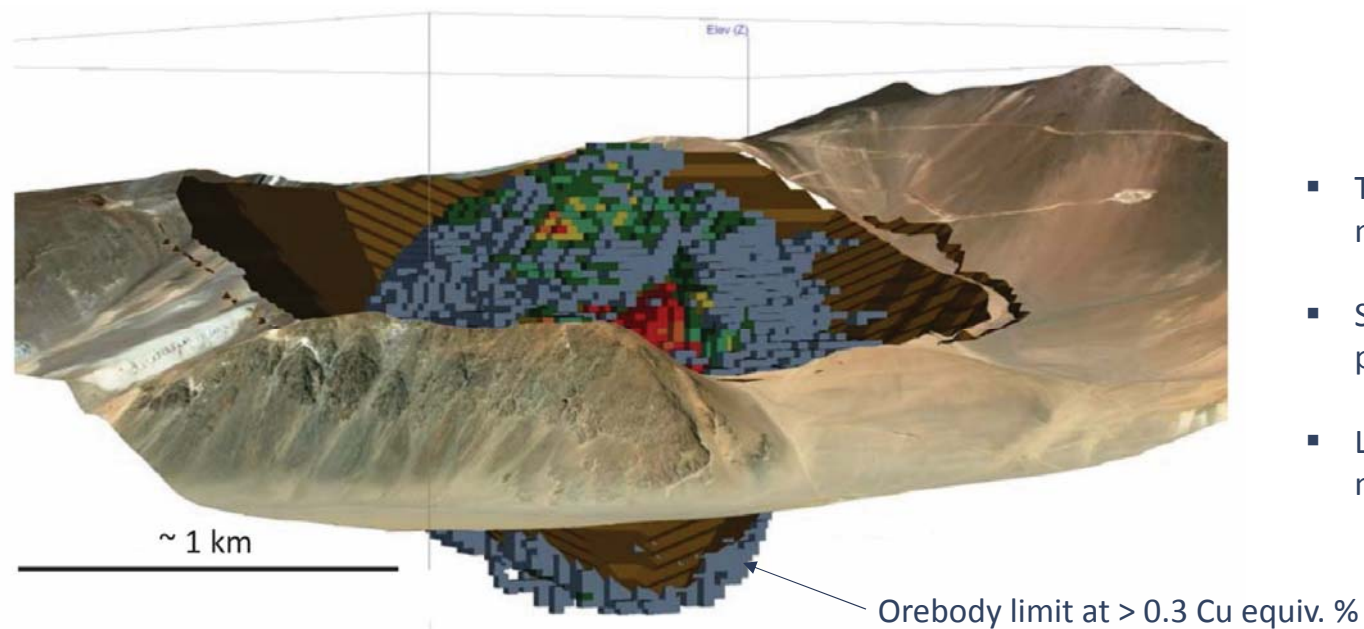


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# Josemaría

## 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

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

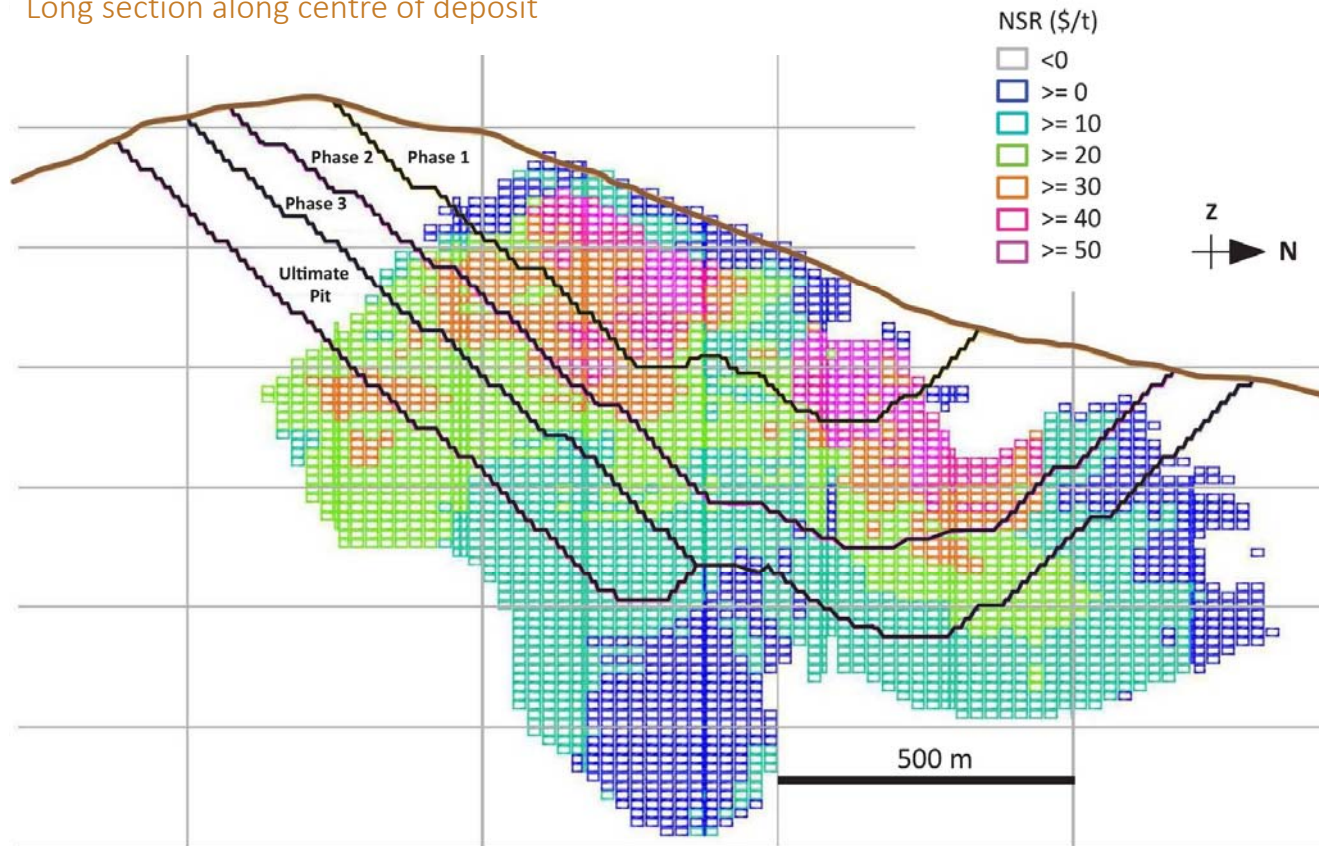
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# Josemaría

## High-grade near surface, clean concentrate



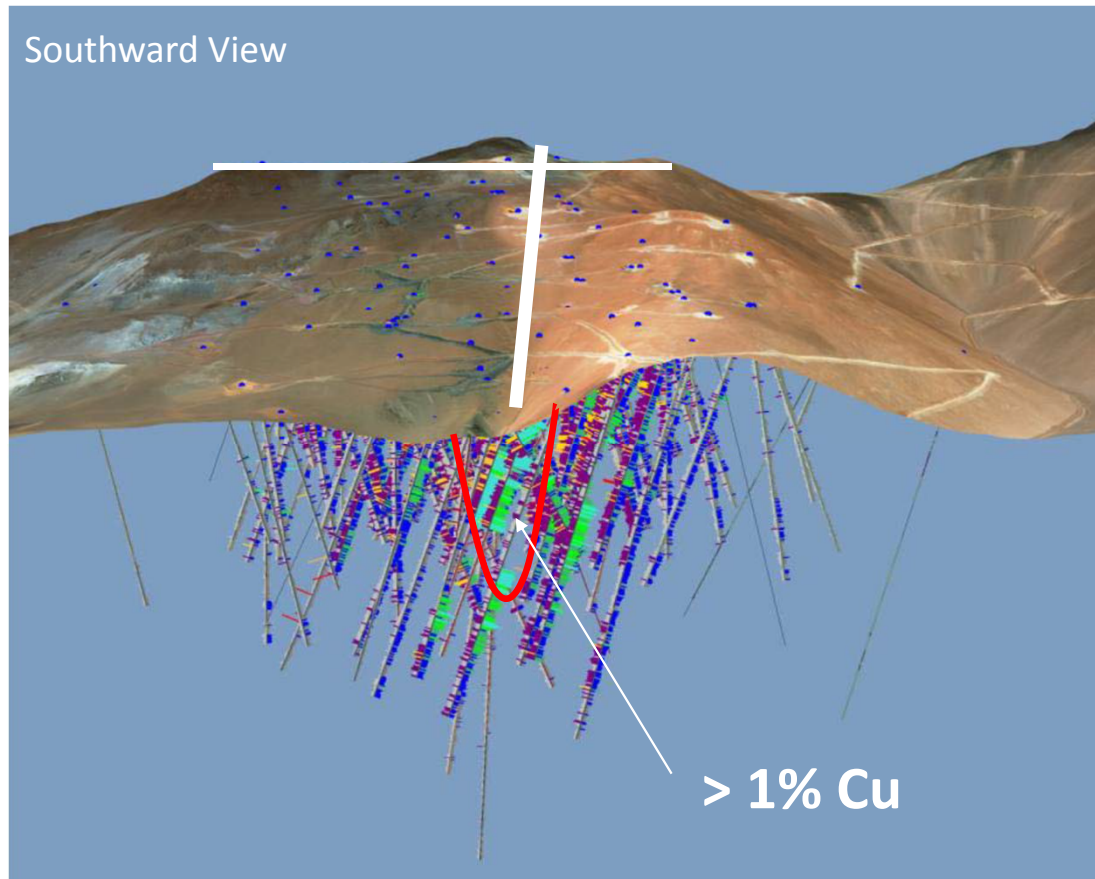
Long section along centre of deposit



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# Josemaría

## N – NE trend to hypogene and supergene mineralization

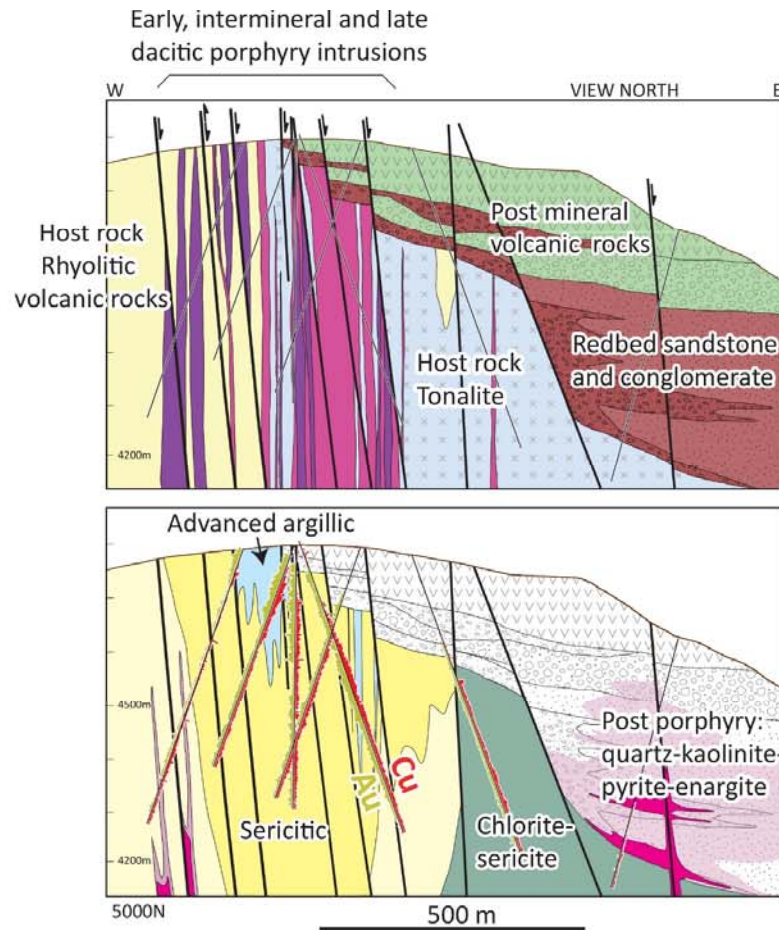


A northward trend within the deposit includes:

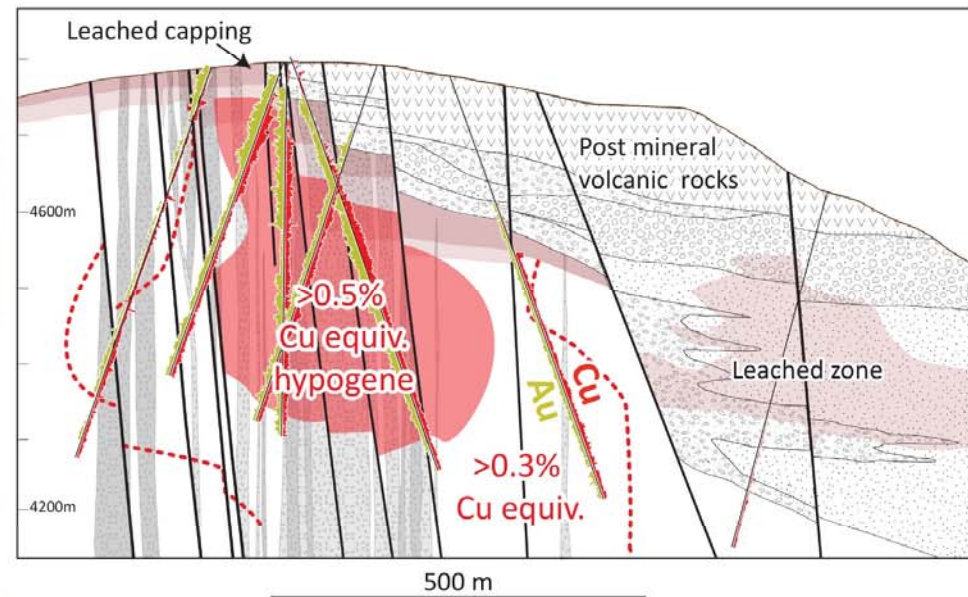
- Premineral lithological contact/structure that localized porphyry emplacement
- Shallow supergene-enriched Cu zone
- Post-mineral normal faults
- A deeper, focused supergene Cu zone

# Josemaría

## Geologic section, southern (upper) part of the deposit



View North



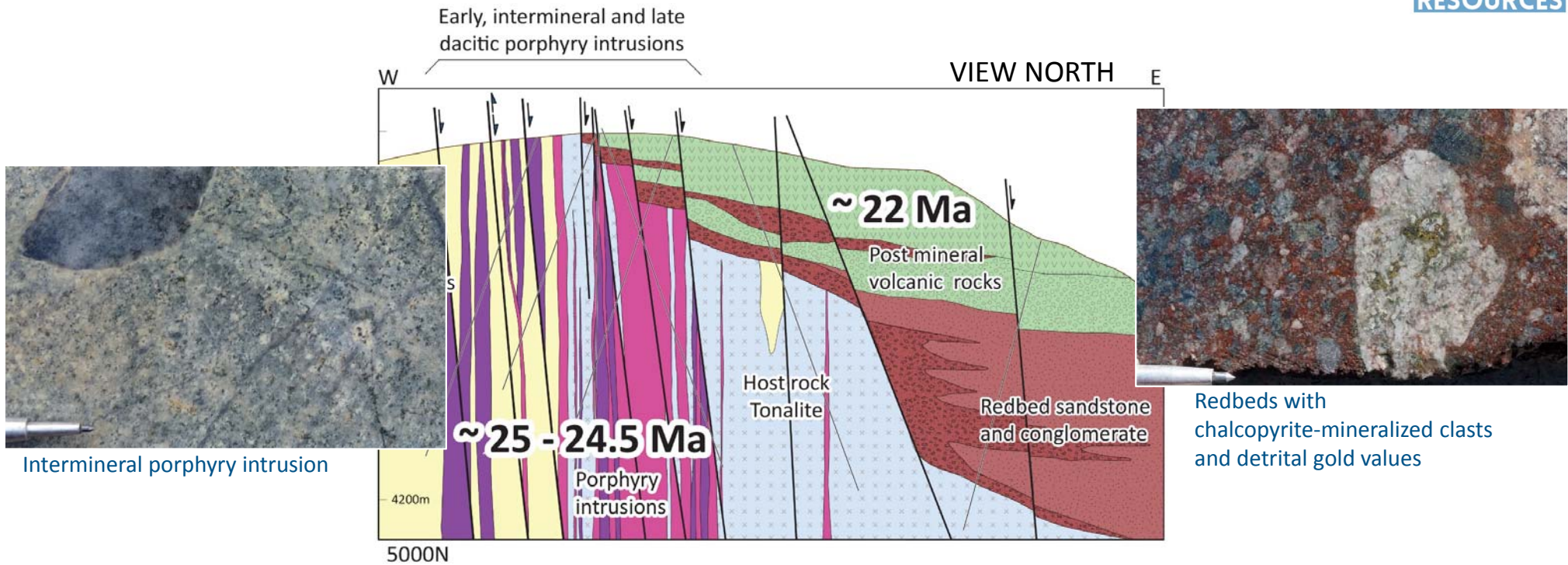
Modified from:

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.

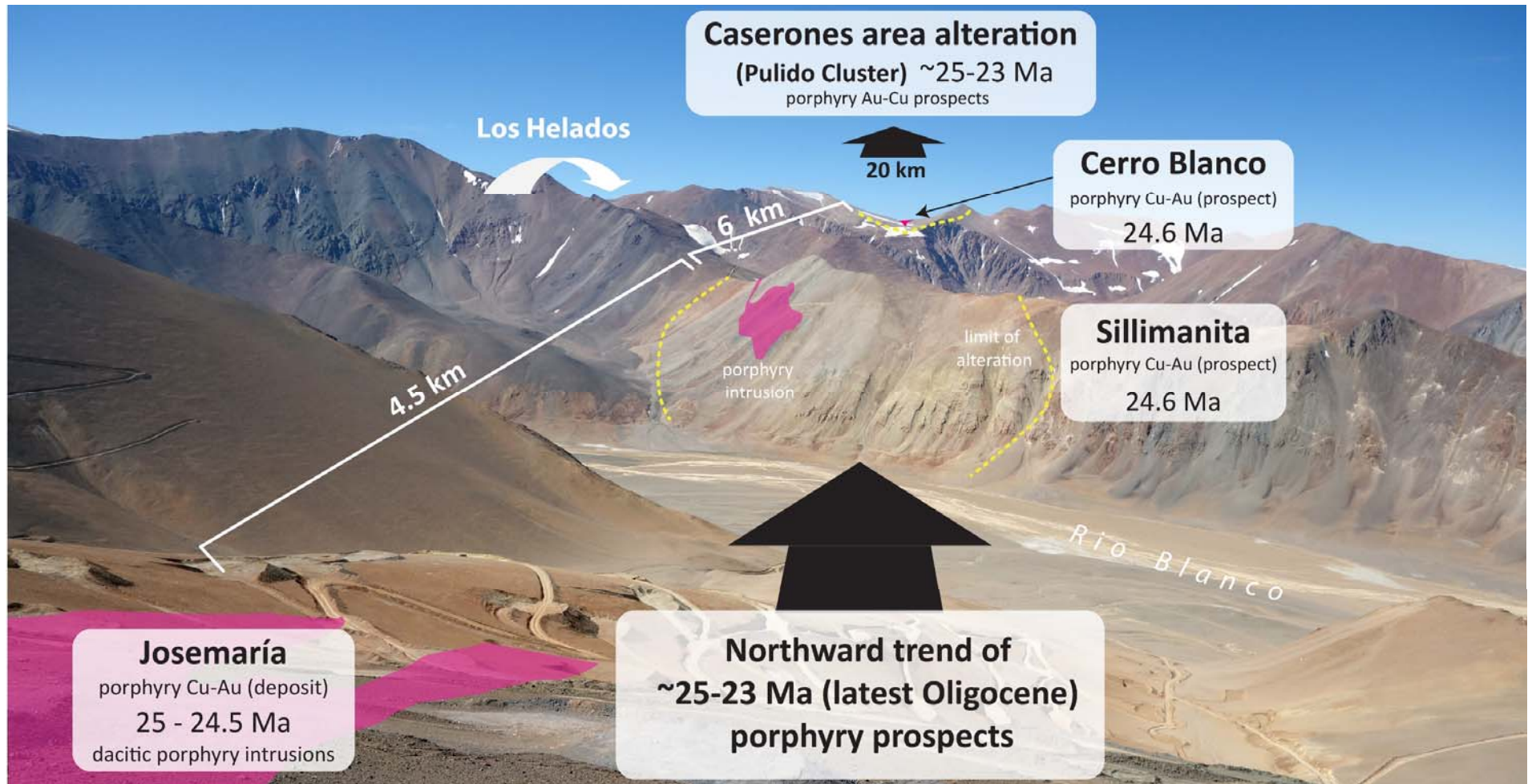


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# Josemaría

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

Major mineral deposits  
(latest Oligocene - Miocene)

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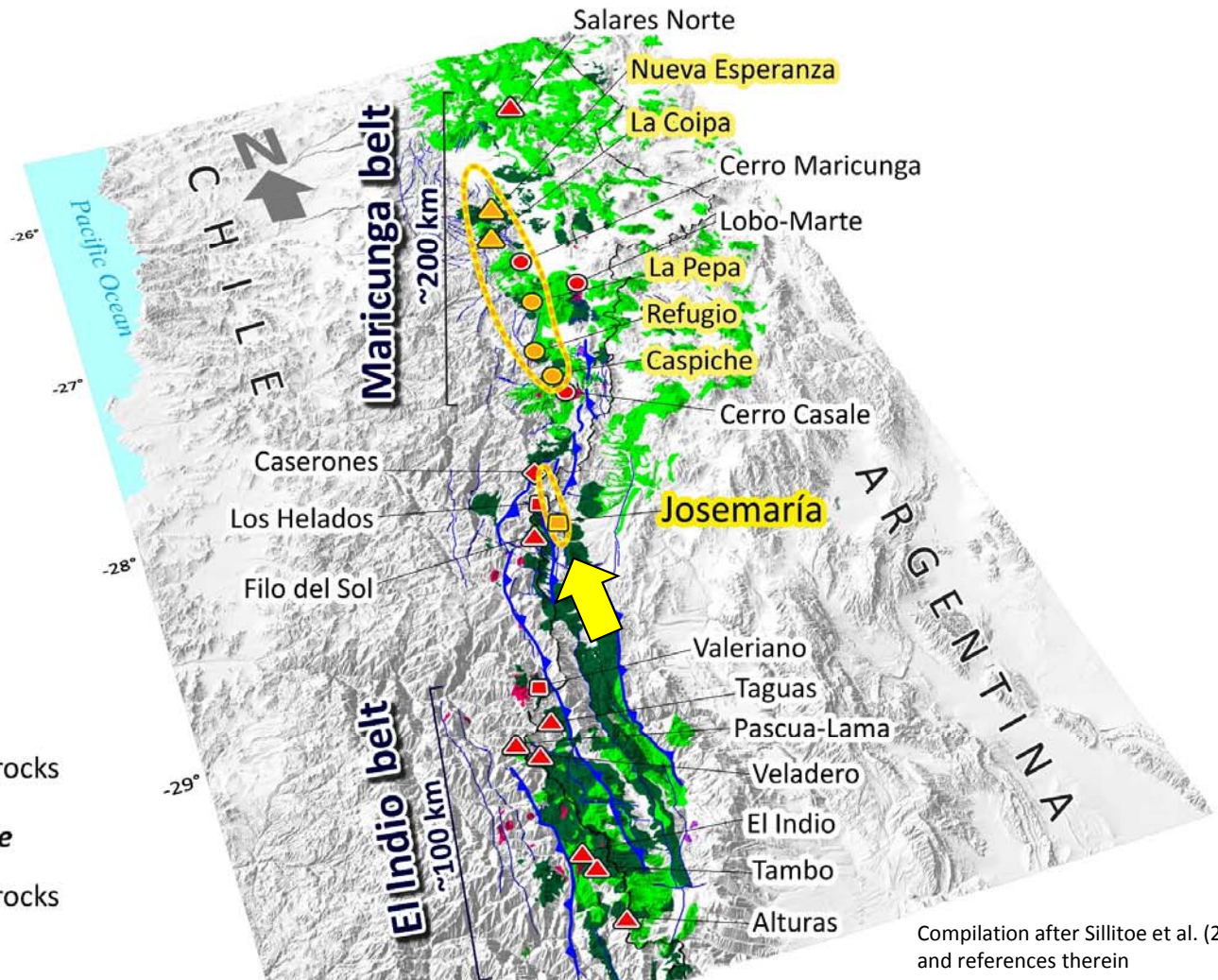
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**Mid - late Miocene**

■ Volcanic and sedimentary rocks

**latest Oligocene - early Miocene**

■ Volcanic and sedimentary rocks



Compilation after Sillitoe et al. (2019)  
and references therein

# Mid to Late Miocene Mineralization

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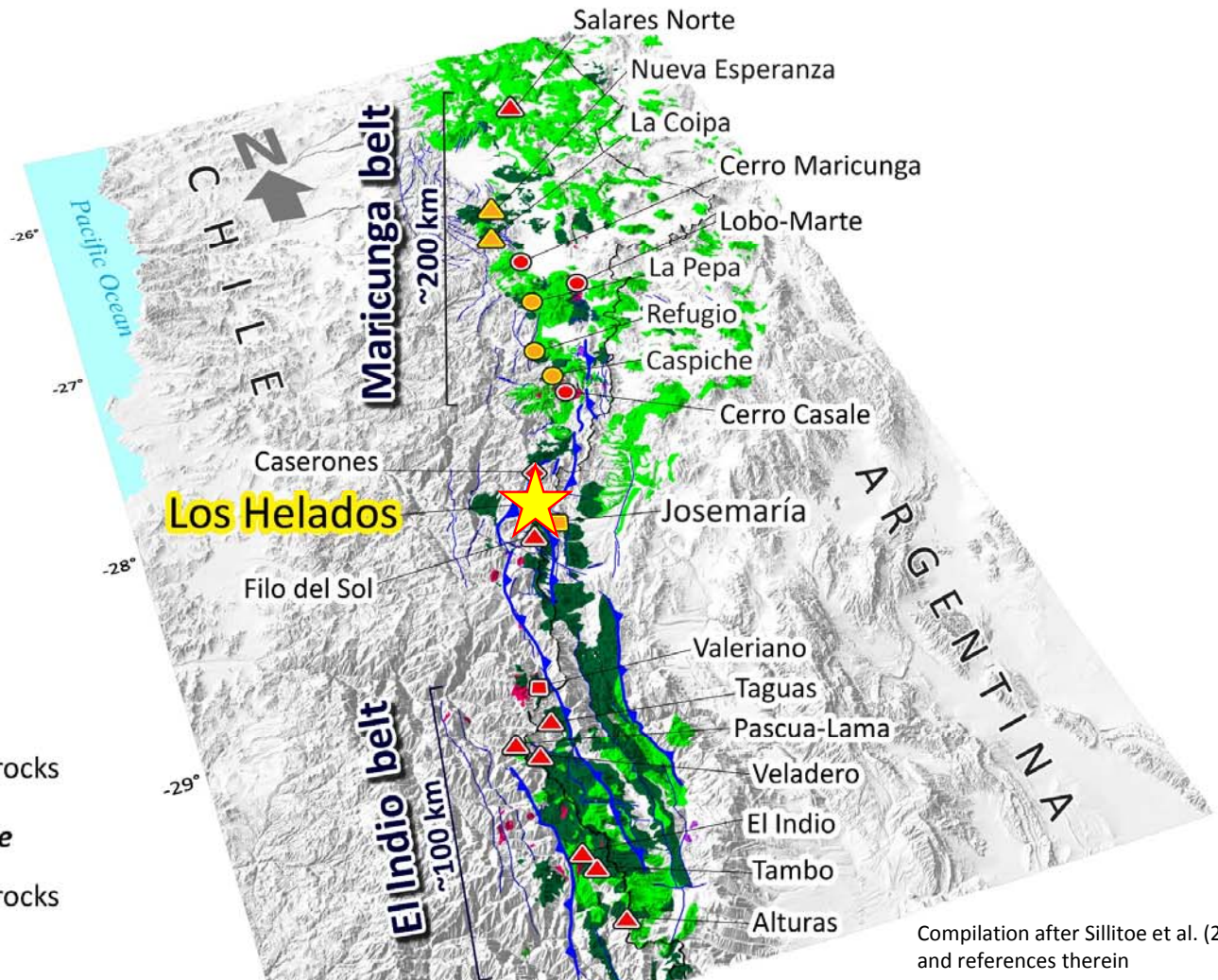
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Compilation after Sillitoe et al. (2019)  
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Los Helados

Porphyry Cu-Au

Chile



Joint Exploration Agreement

63% NGEx Minerals

37% Pan Pacific Copper Co.



A grassroots discovery by NGEx Resources in 2008

Los Helados

Porphyry Cu-Au

Chile



Joint Exploration Agreement  
63% NGEx Minerals  
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A grassroots discovery by NGEx Resources in 2008

# Los Helados

# Porphyry Cu-Au

# Chile



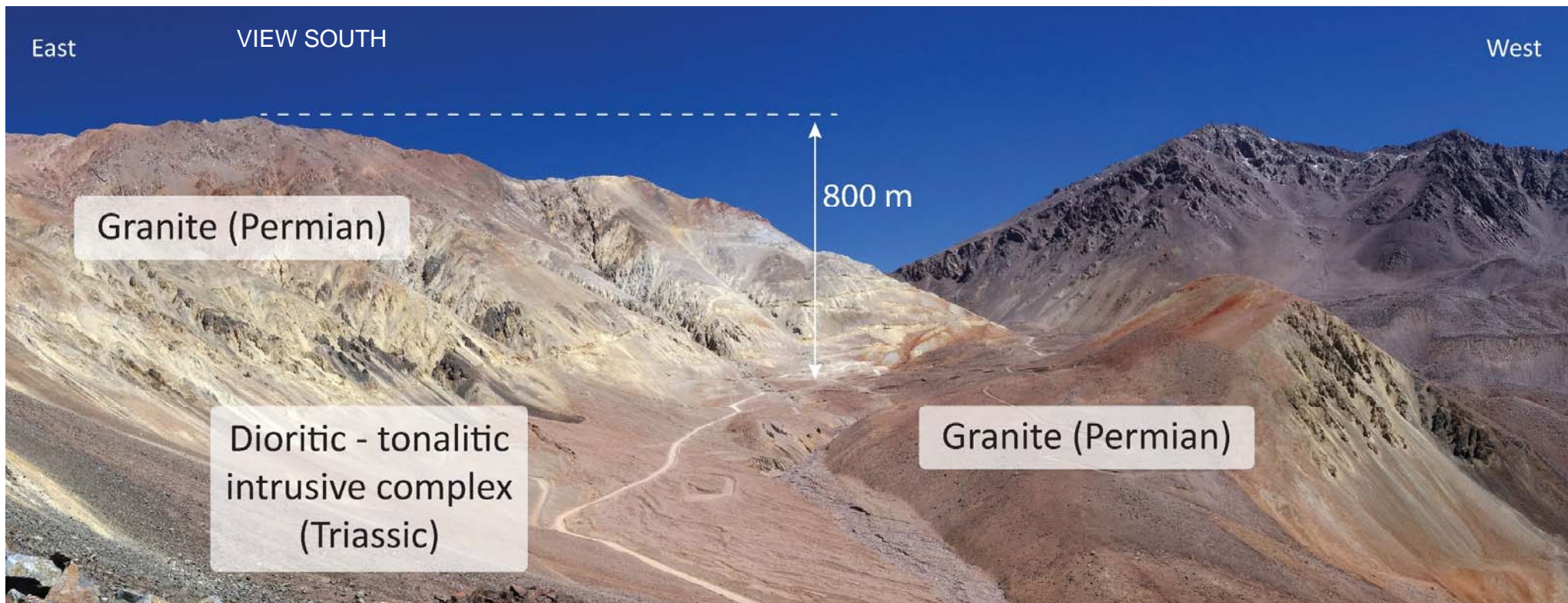
VIEW SOUTH



- 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





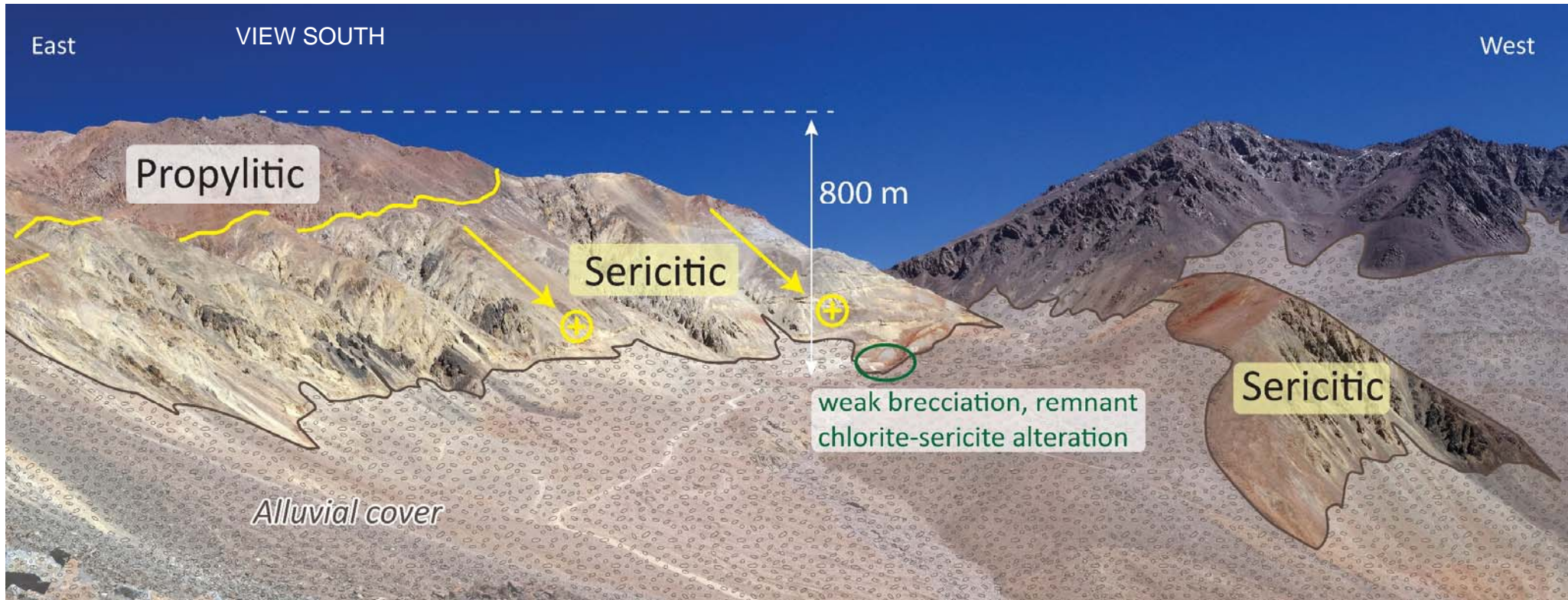
# Los Helados

Permian – Triassic host rocks



# Los Helados

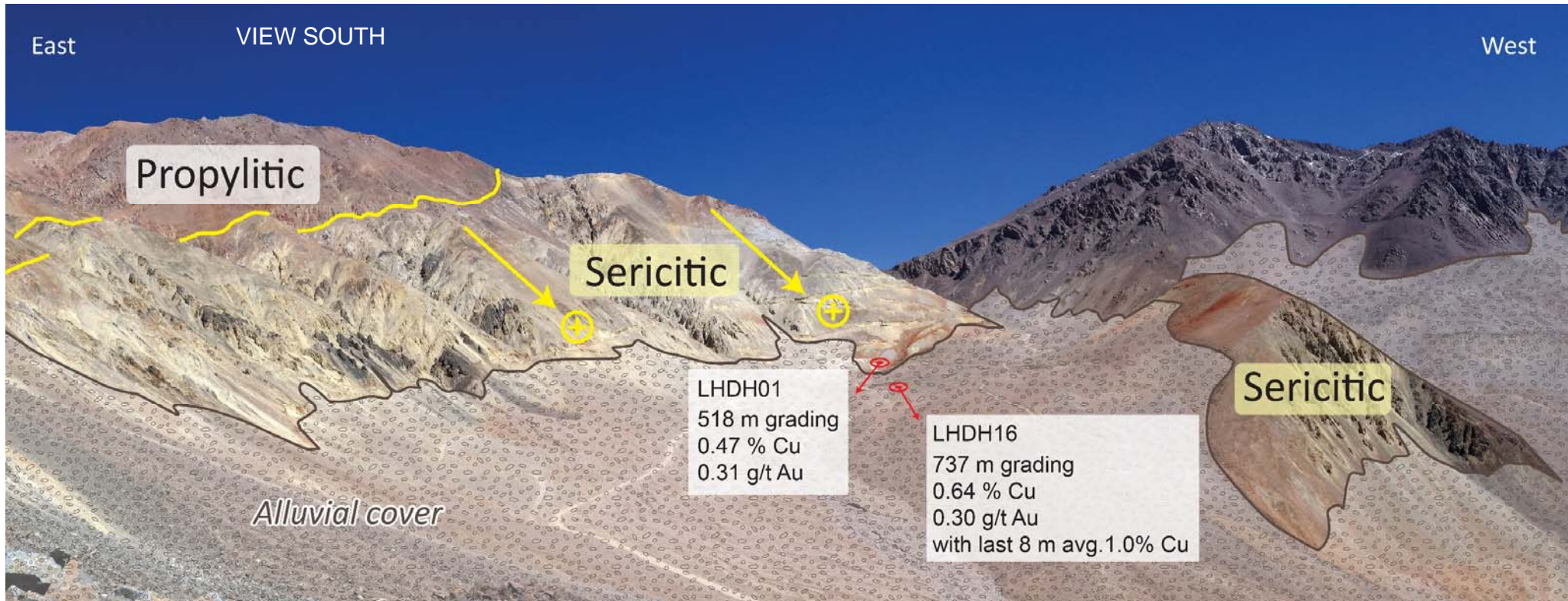
## Alteration vectors



- Increasing intensity of sericitic alteration with incipient breccia at lowest elevation.
- Targeting supported by IP and soil geochemistry

# Los Helados

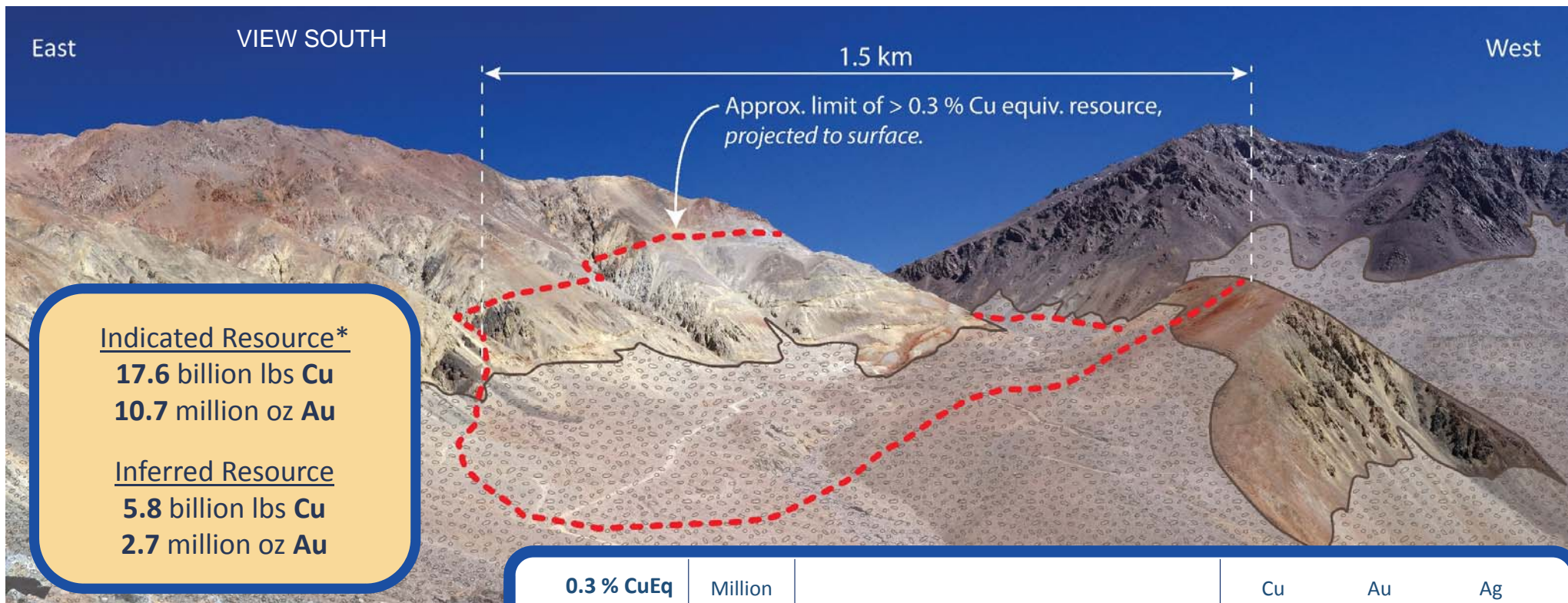
## Drilling to discovery



- 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**

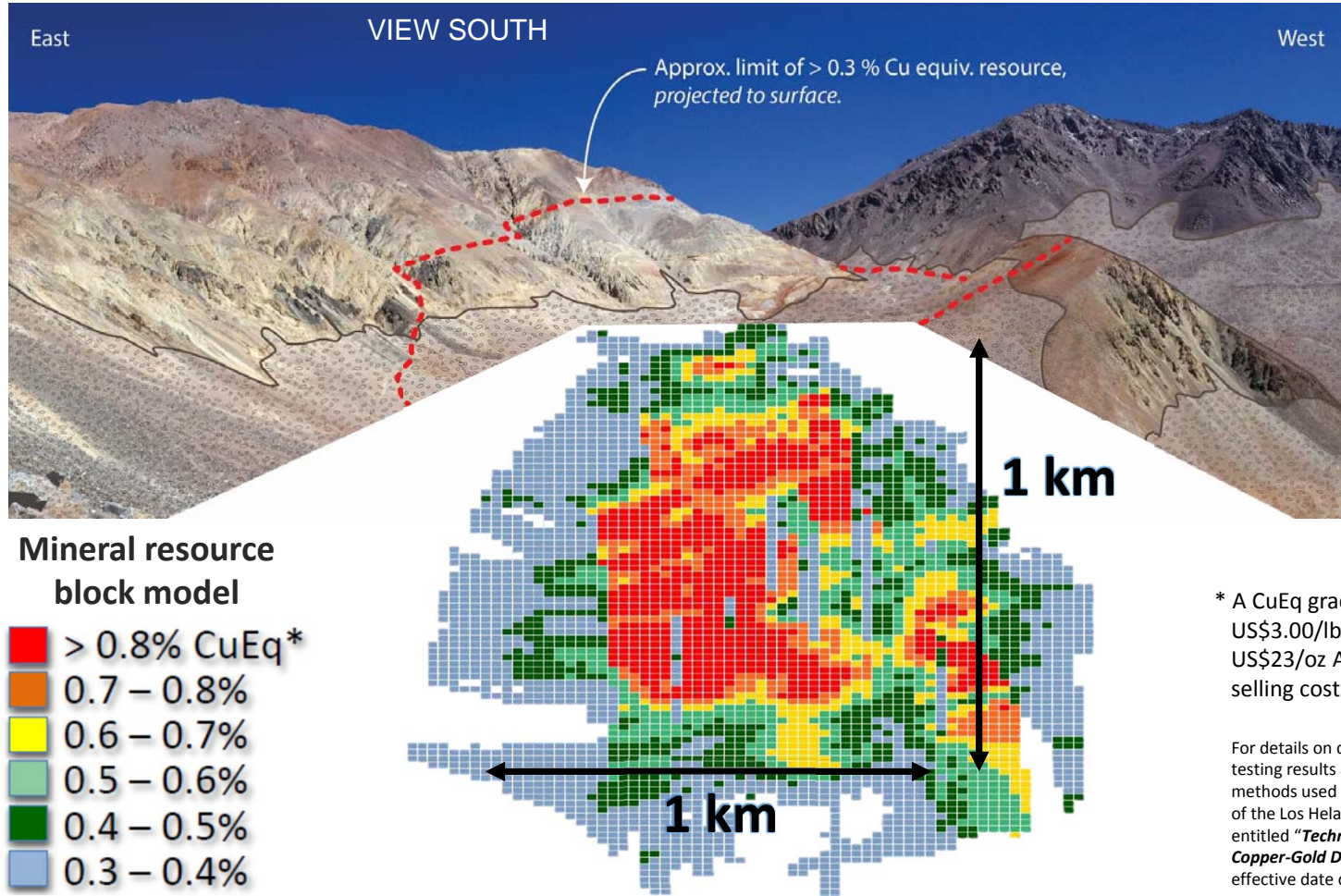
<b>0.3 % CuEq cutoff</b>	Million tonnes	Cu (%)	Au (g/t)	Ag (g/t)	CuEq (%)	Cu (billion lbs)	Au (million oz)	Ag (million oz)
Indicated	<b>2,099</b>	<b>0.38</b>	<b>0.15</b>	1.37	<b>0.48</b>	17.6	10.1	92.5
Inferred	<b>827</b>	0.32	0.10	1.32	<b>0.39</b>	5.8	2.7	35.1

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

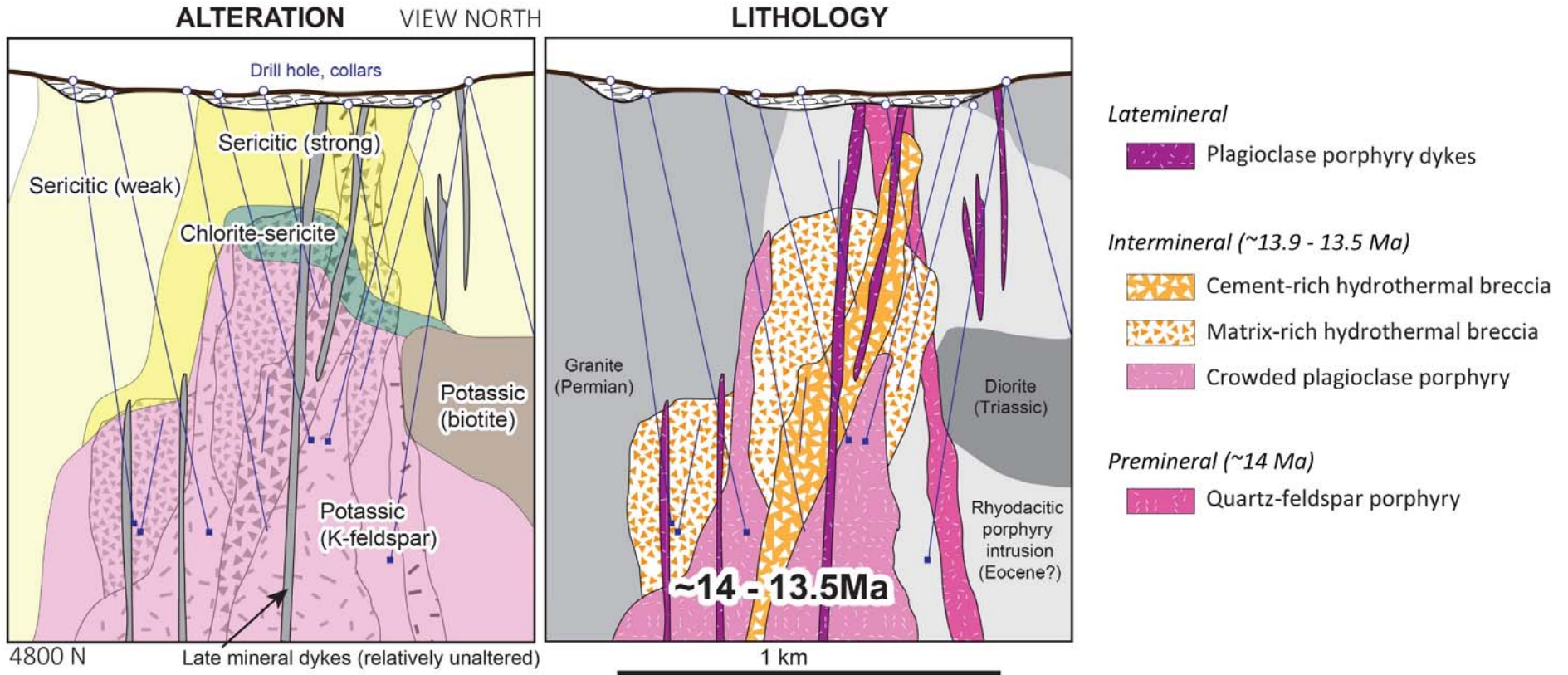


\* A CuEq grade was calculated using US\$3.00/lb Cu, US\$1,300/oz Au and US\$23/oz Ag, and includes a provision for selling costs and metallurgical recoveries.

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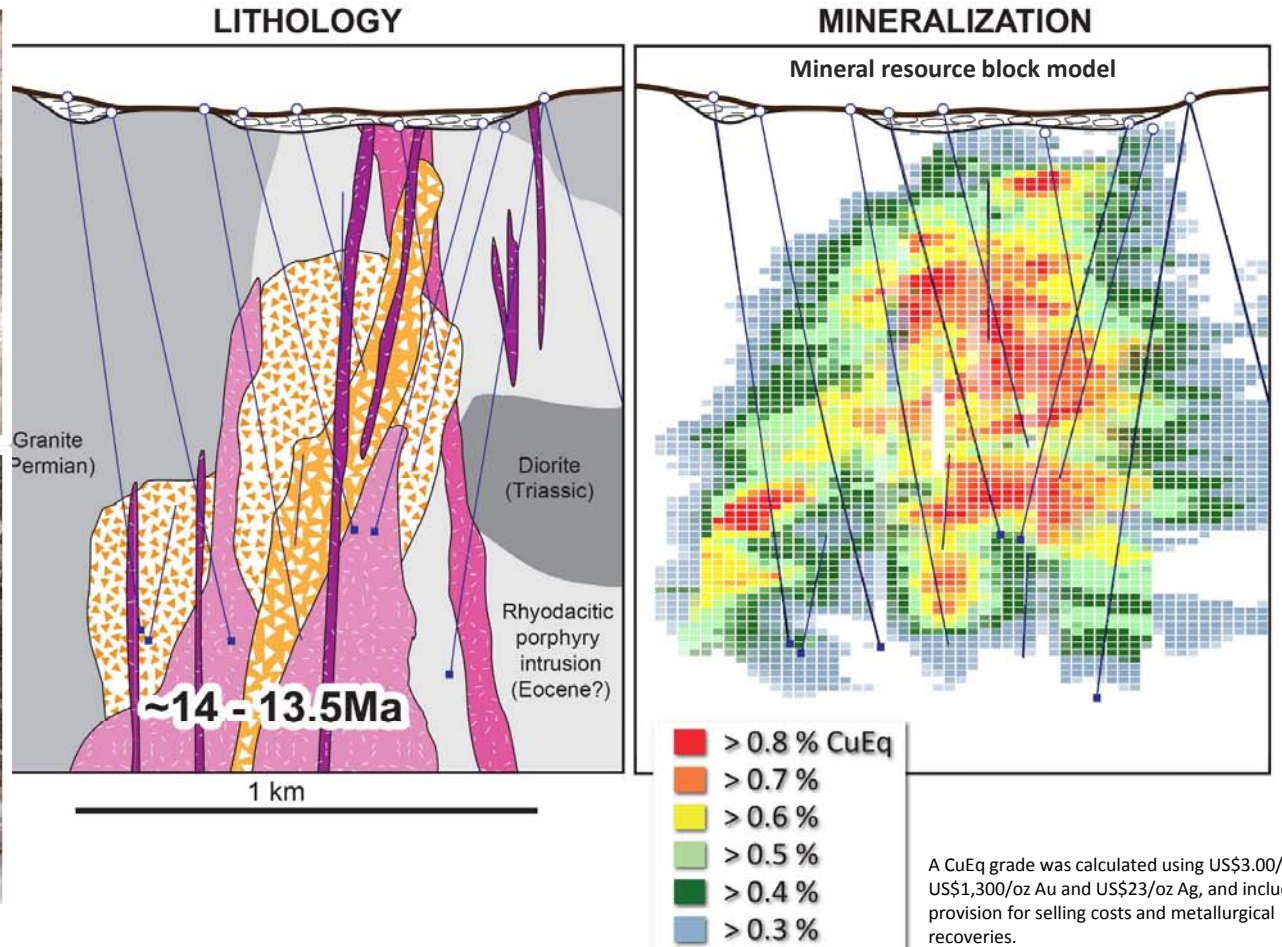
## High-grade sulphide-cemented breccias



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

# Los Helados

## High-grade sulphide-cemented breccias



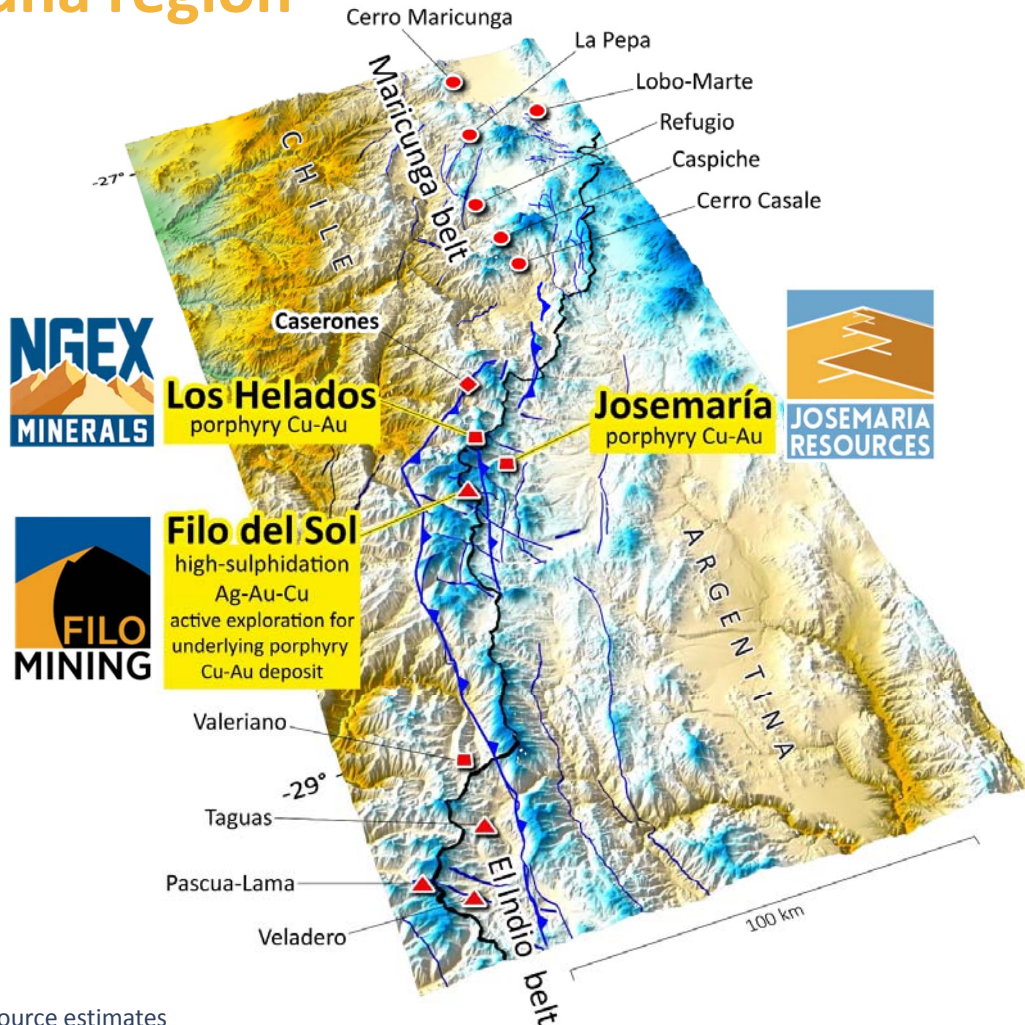
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Description of the mineral resource block model found in: *“Technical Report on the Los Helados Porphyry Copper-Gold Deposit Chile”* dated August 6, 2019 with an effective date of April 26, 2019, available on SEDAR and on the Company’s website

# The Vicuña region



A great story of **grassroots exploration success** by a junior company.

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