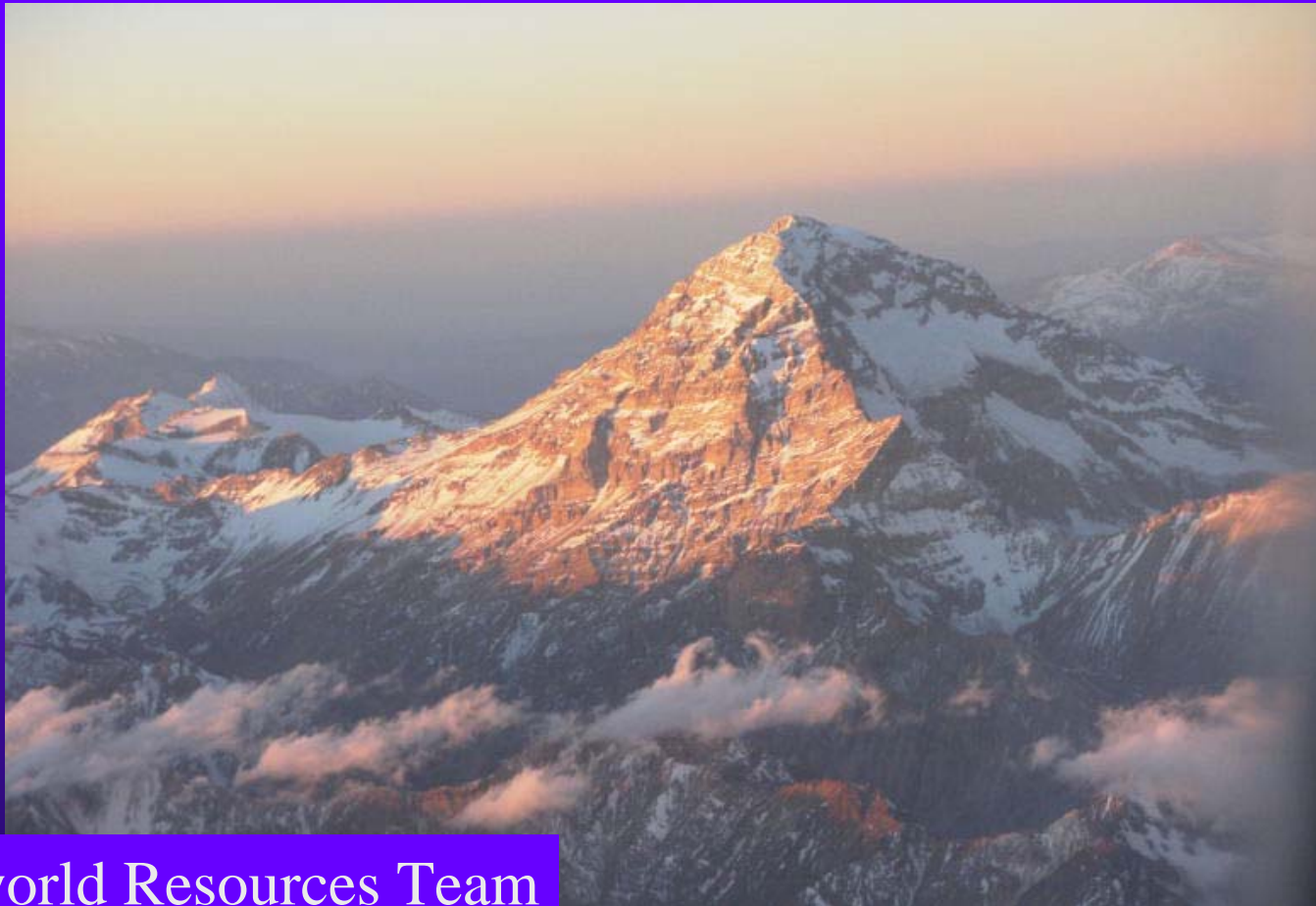


Polymetallic Ag-Au veins of South and Central America



Underworld Resources Team

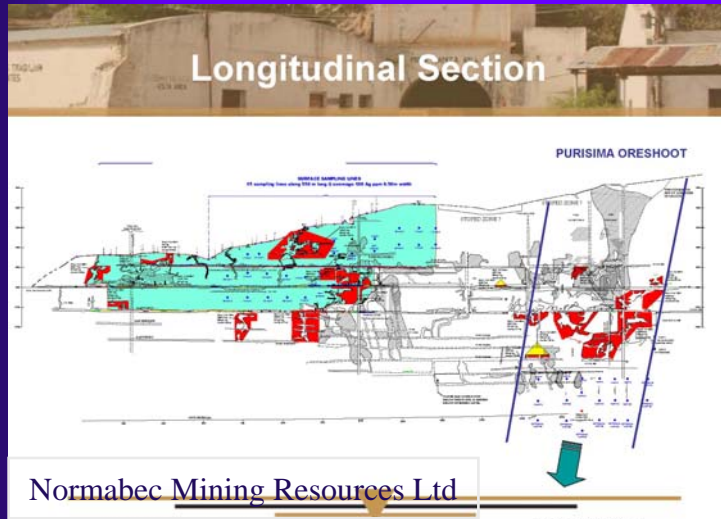
Polymetallic Ag-Au

- ◆ Typically vein systems in which Ag-Au occur with sulphides: pyrite > sphalerite > galena > chalcopyrite with electrum, Ag sulphosalts (tennantite-tetrahedrite, argentite)
- ◆ Gangue: quartz, carbonate & minor barite
- ◆ Part of the sulphide-rich intrusion-related low sulphidation epithermal deposit group
- ◆ Andean equivalent of the SW Pacific carbonate-base metal Au.

Why Explore for them?

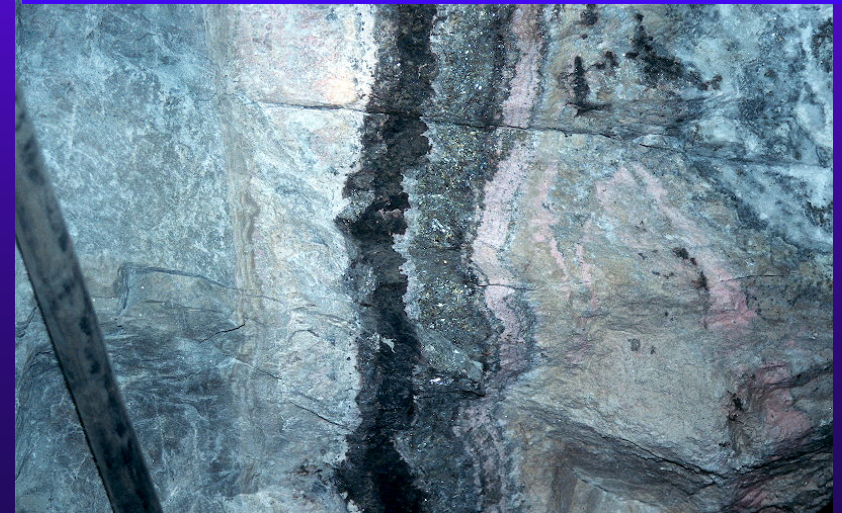
- ◆ Important historical producers
- ◆ Still underexplored and can be significant discoveries for Junior exploration companies
- ◆ Mineralogical and alteration zonation vector towards ore

Andean Polymetallic Au-Ag historical Au-Ag producers

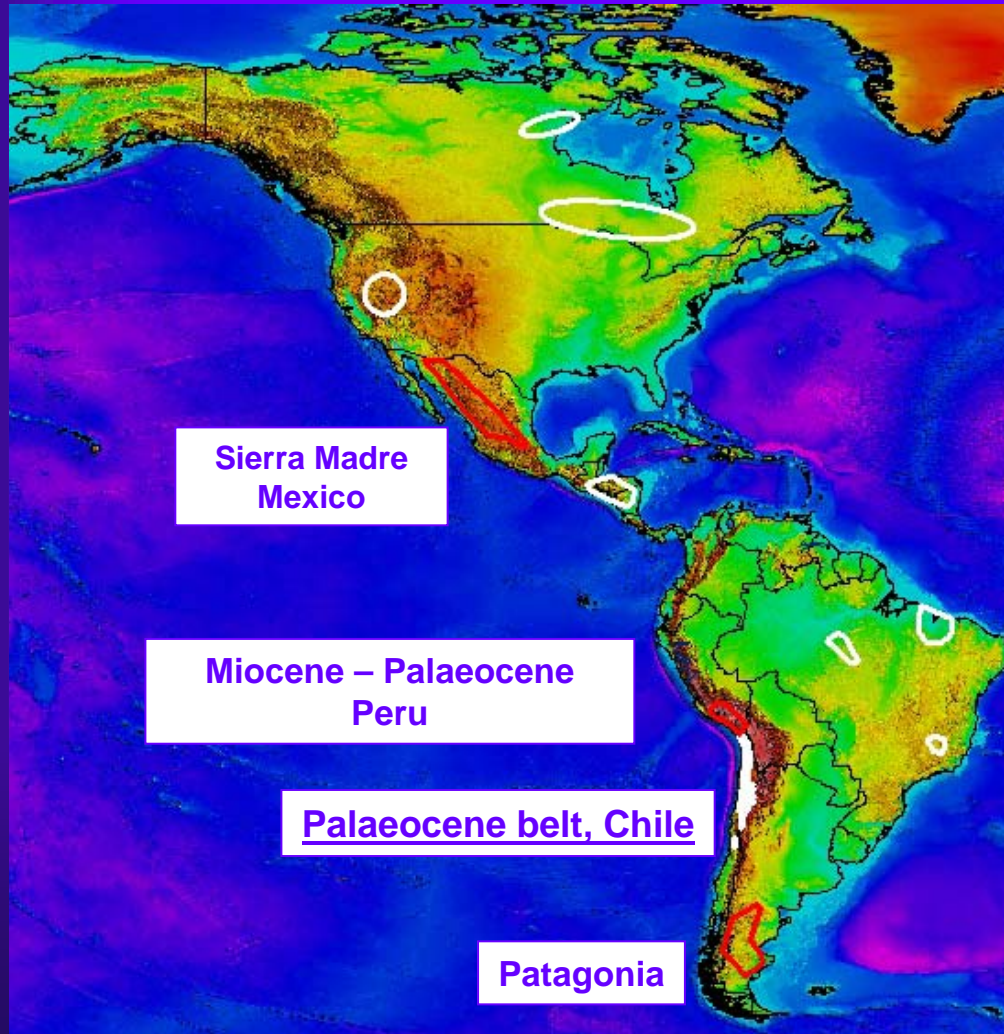


Veta Madre, Guanajuato, Mexico

Caylloma, Peru (Fortuna Silver)



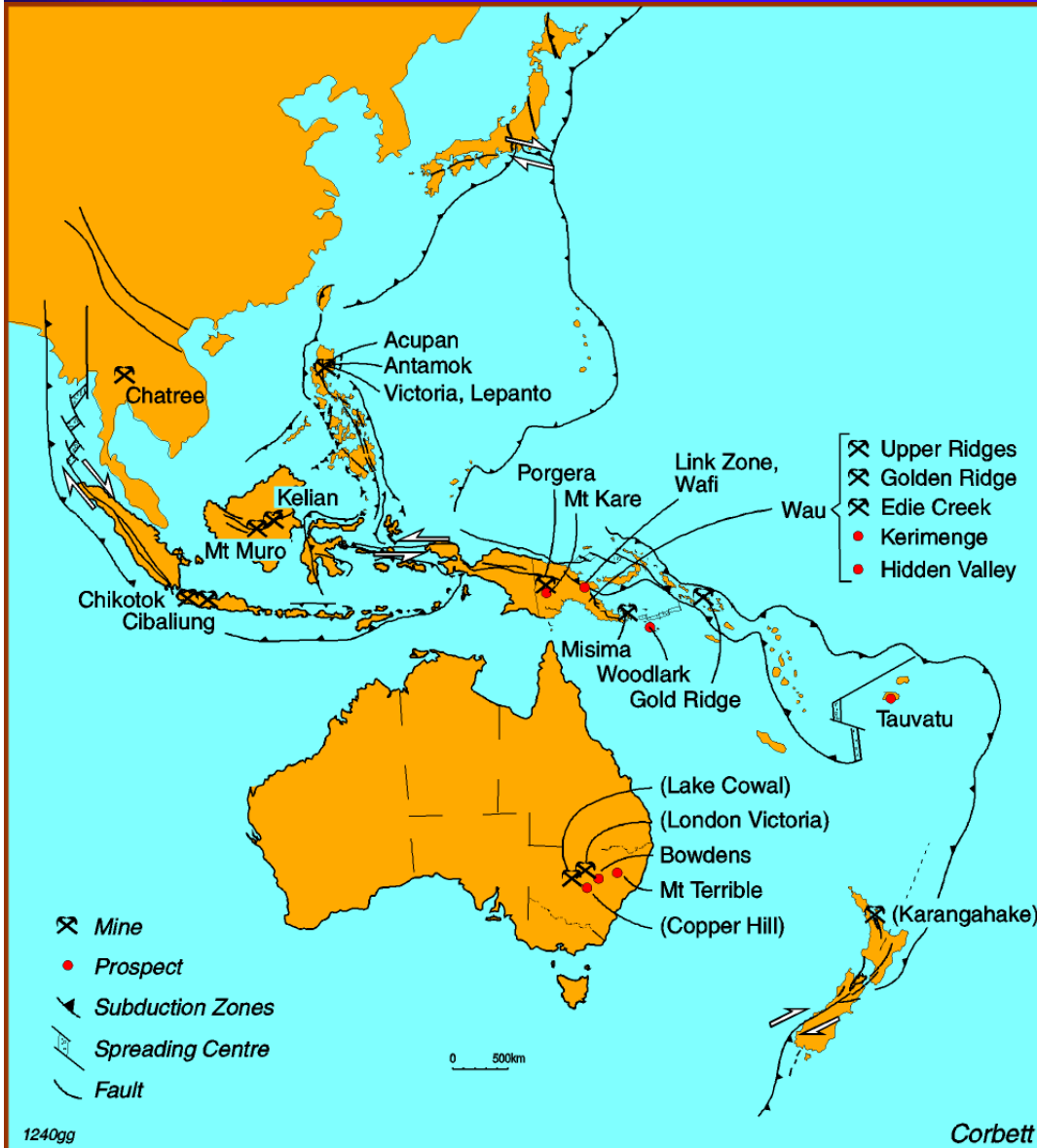
Polymetallic Au-Ag Deposits – Regional Setting



- ◆ Polymetallic Ag fissure veins best developed in a continental setting:
 - strongly extensional magmatic arcs underlain by continental crust (Sierra Madre, Mexico)
 - extensional portions of compressive magmatic arcs (Peru),
 - back arc boundaries to magmatic arcs (Patagonia)

Carbonate-base metal Au –

Leach and Corbett, 1993, 1994, 1995; Corbett and Leach, 1998

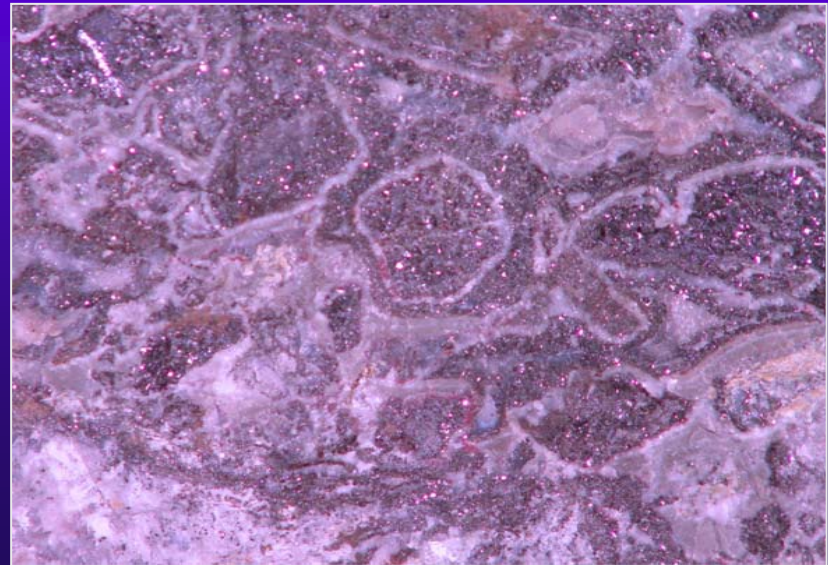
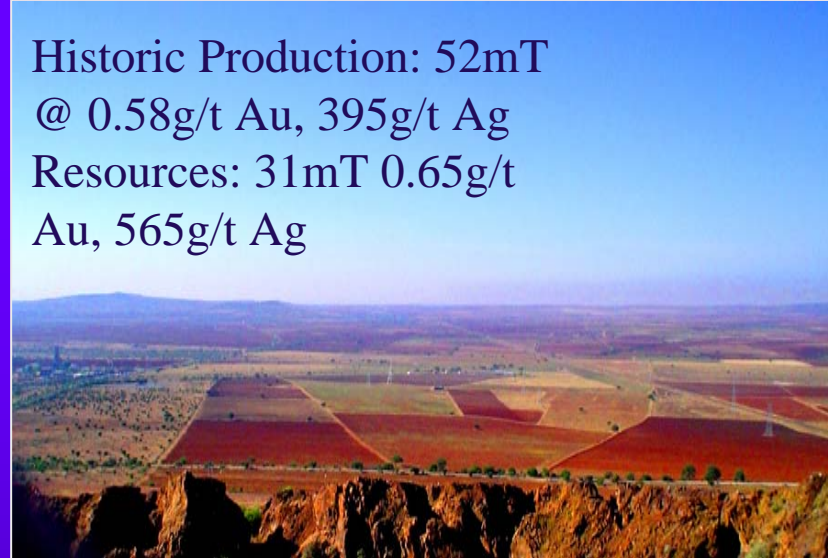


- ◆ Considered the equivalent of the gold rich carbonate base metal systems of the SW Pacific

Polymetallic Ag-Au – Fresnillo - Mexico

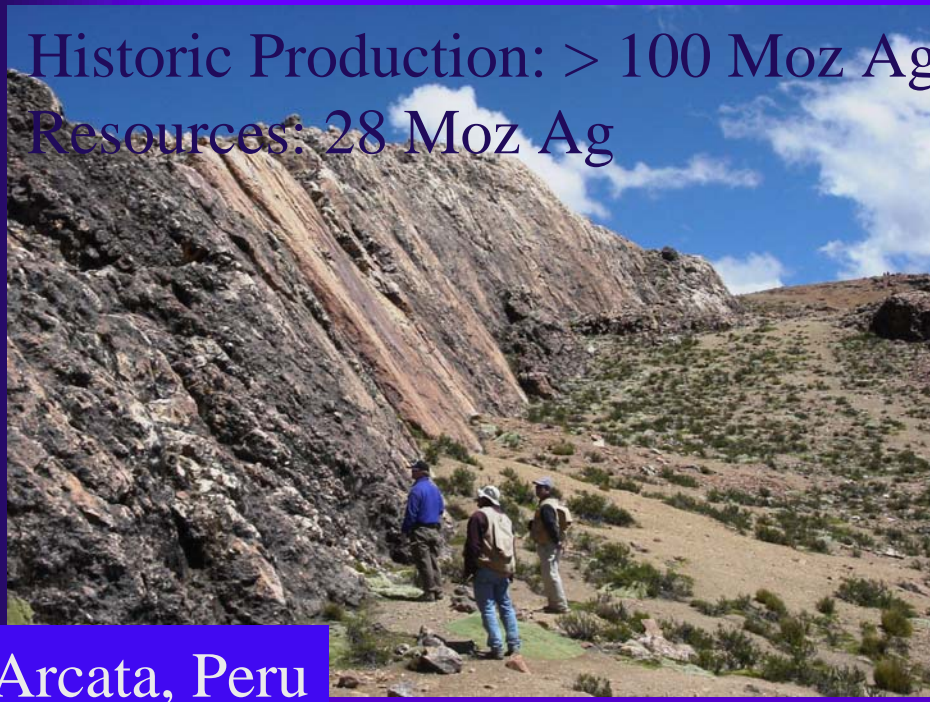


Historic Production: 52mT
@ 0.58g/t Au, 395g/t Ag
Resources: 31mT 0.65g/t
Au, 565g/t Ag

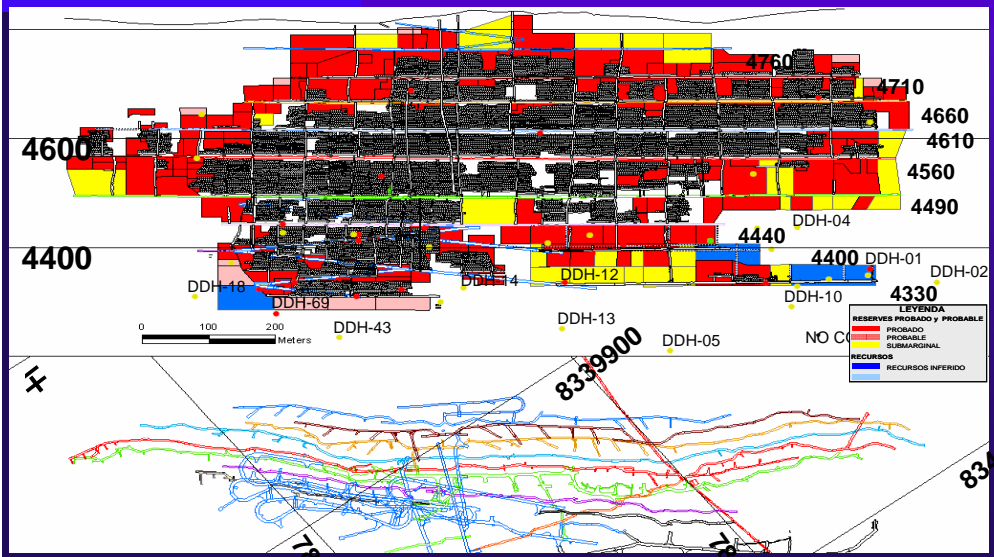


Andean Polymetallic Au-Ag - Peru

Historic Production: > 100 Moz Ag
 Resources: 28 Moz Ag



Arcata, Peru

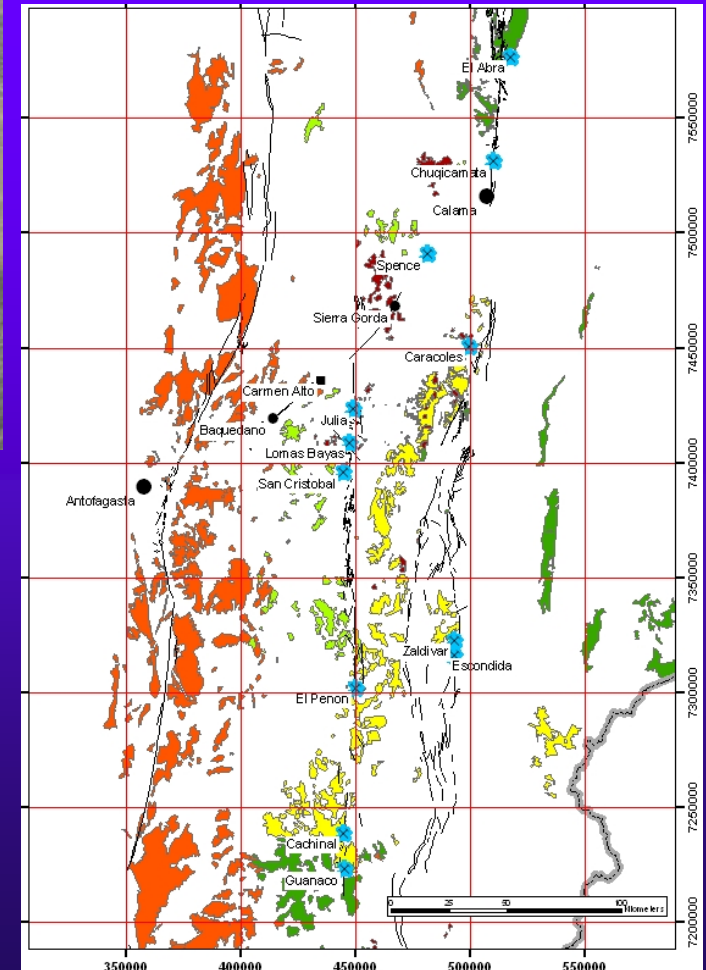


El Penon, Chile

Past Production: 5.6mT @ 11.9g/t Au, 200g/t Ag

Reserves: 9.26mT @ 6.61g/T Au, 274g/t Ag

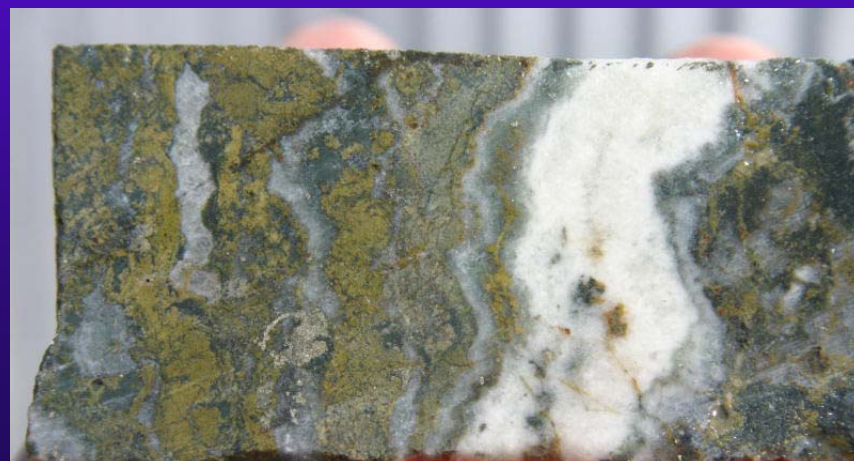
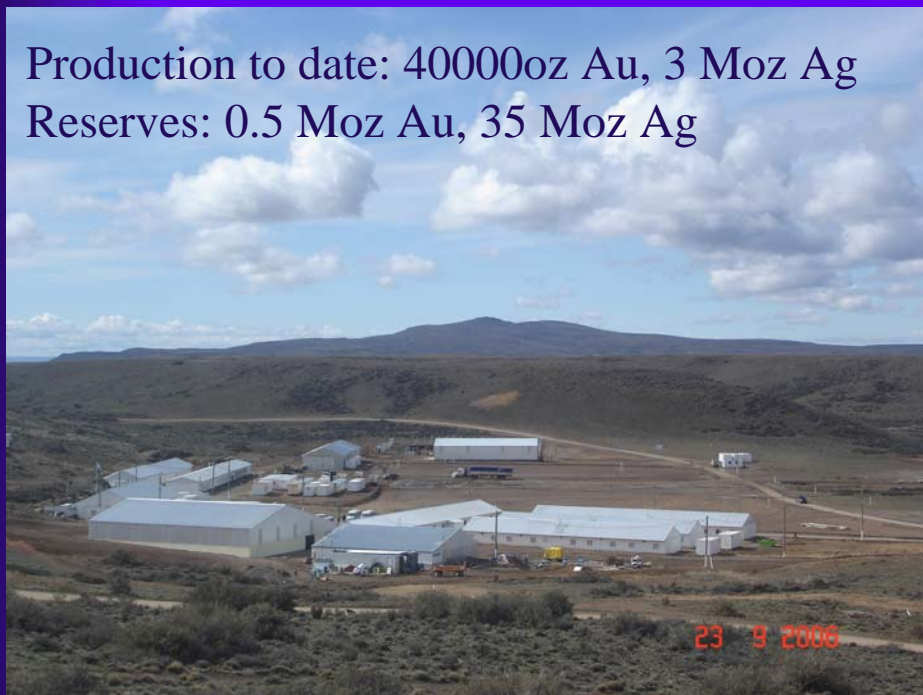
Polymetallic Ag-Au - Chile



Polymetallic Ag-Au - Argentine Patagonia

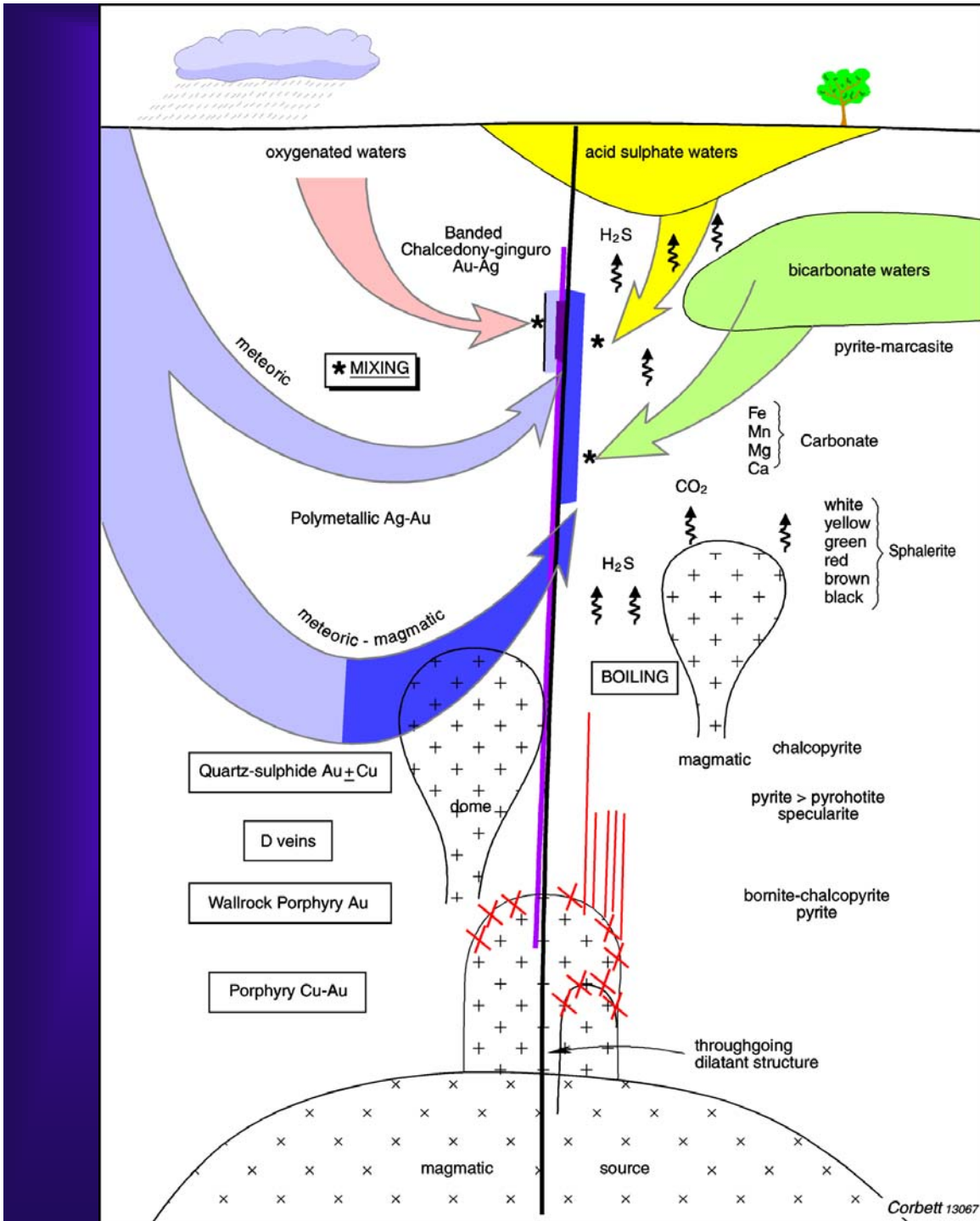
San José (Huevos Verdes),
Argentina

Production to date: 40000oz Au, 3 Moz Ag
Reserves: 0.5 Moz Au, 35 Moz Ag



Vertically zoned

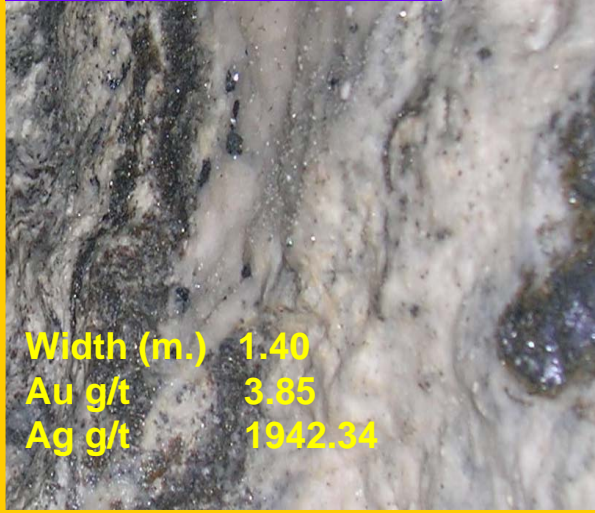
- ◆ Transitional into banded chalcedony-ginguro Au-Ag epithermal quartz veins
- ◆ Central portions pyrite-(yellow to red) sphalerite > galena, tennantite-tetrahedrite with a quartz and carbonate gangue
- ◆ Transitional from early typically deeper level Au-rich quartz-pyrite-chalcopyrite



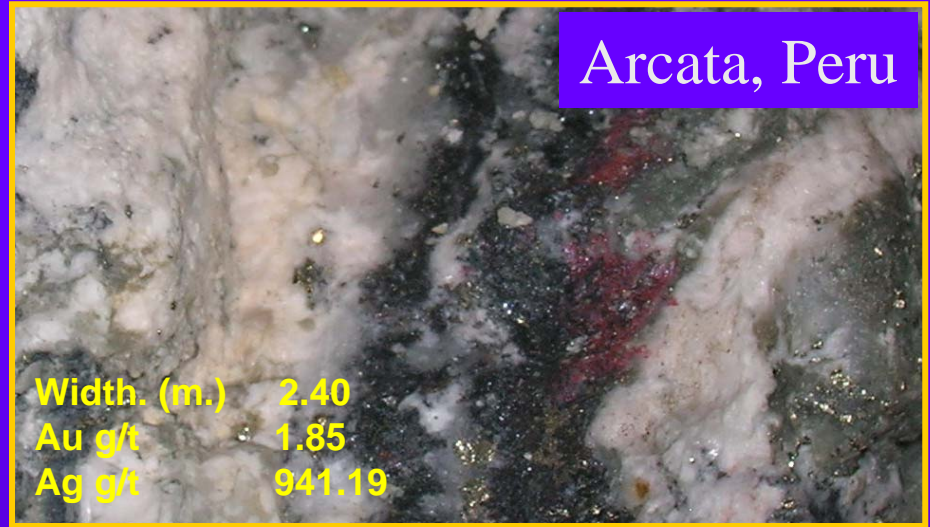
Zonation in polymetallic Ag-Au systems

Typical polymetallic mineralization

Caylloma, Peru



Arcata, Peru



Epithermal end
member of
Polymetallic Ag-Au
- cubic pyrite-white
sphalerite-Ag sulphosalts



Cerro Negro, Patagonia



Huevos Verdes vein, Patagonia



Some controls to polymetallic Ag-Au low sulphidation epithermal veins

- ◆ **Host rock** - competency the key
- ◆ **Structure** – dilation the key
- ◆ **Mechanism of Au-Ag deposition** - Various possibilities

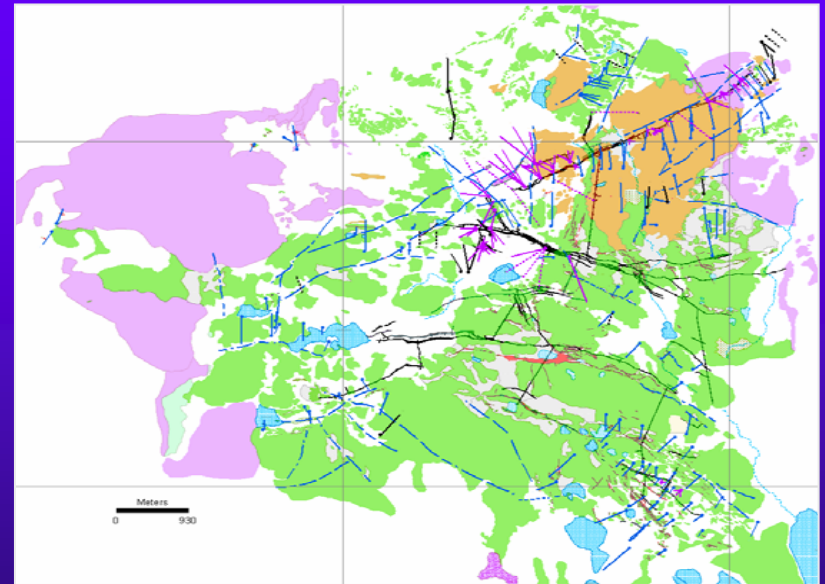
Rock competency



Mariana vein, Arcata



Width (m) : 3.40
Au g/t : 1.69
Ag g/t : 1,156.99



Rock competency - El Peñon, Chile

SCOTT WILSON RPA

www.scottwilsonrpa.com
www.scottwilsonmini.com

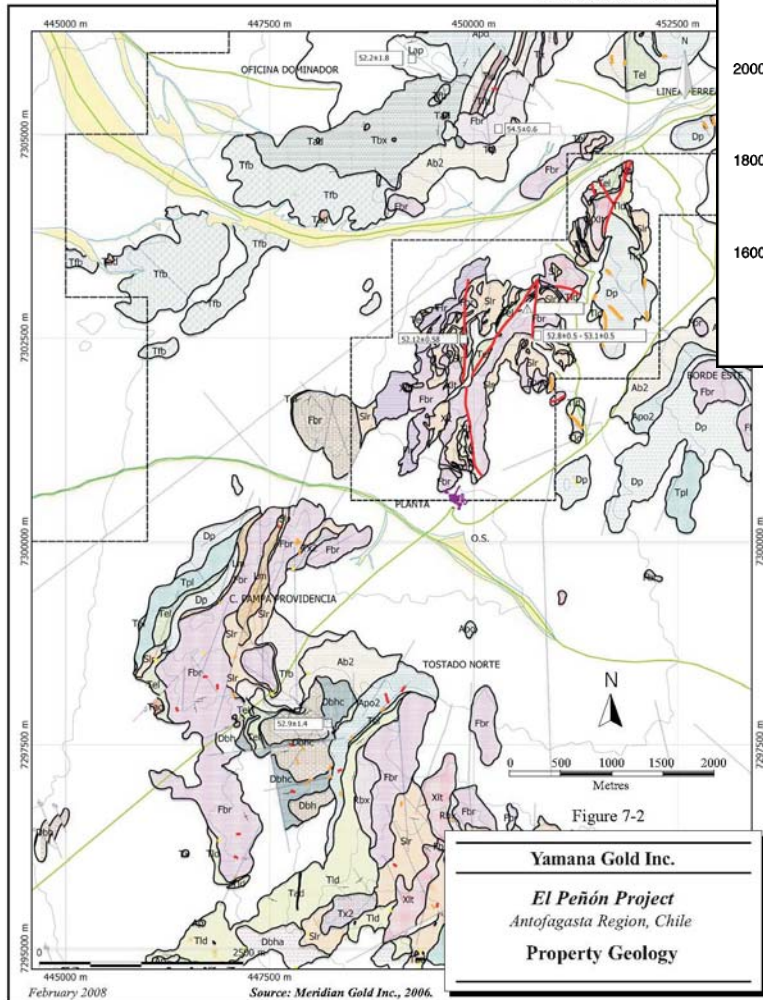
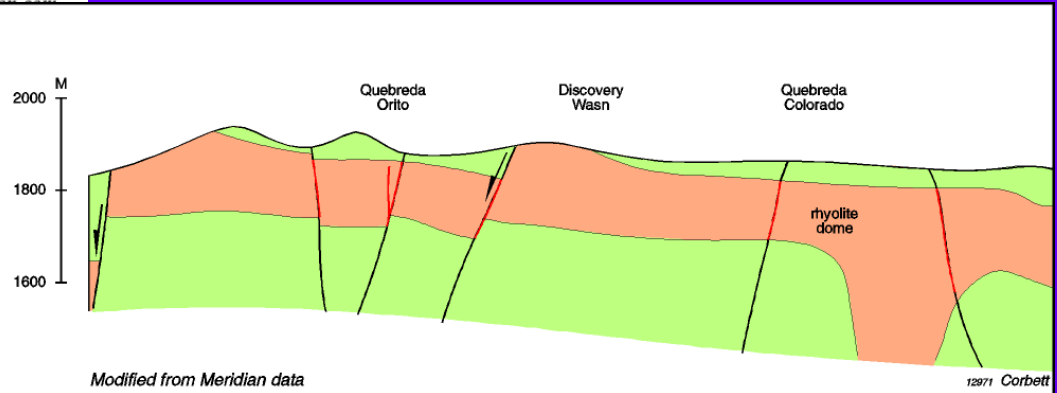


Figure 7-2

Yamana Gold Inc.

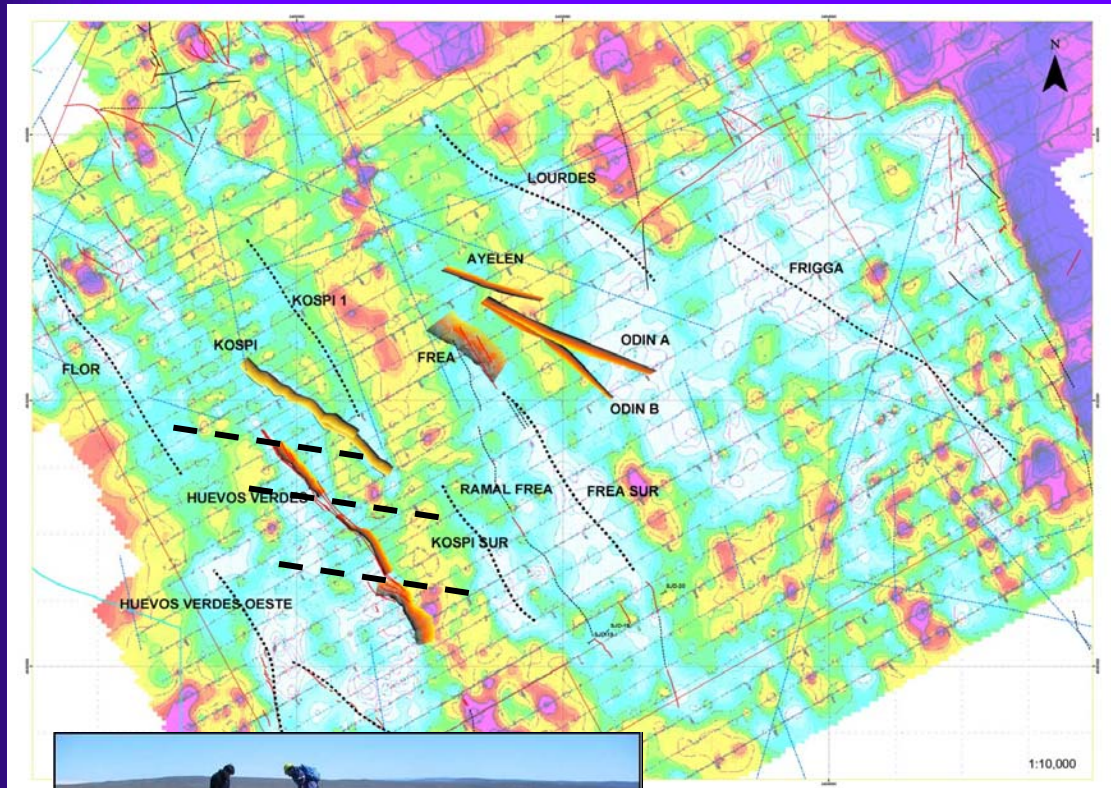
El Peñon Project
Antofagasta Region, Chile
Property Geology



Modified from Meridian data

12871 Corbett

Structure - Dilation



- ◆ Dextral WNW structures produce NW to NNW shoots
- ◆ Sinistral movement along NW to WNW structures produce wider shoot segments in NW sense
- ◆ Also seen in vertical sense on steeper portions of normal faults

Possible field evidence in outcrop/core for deposition mechanisms

◆ Boiling

- rarely seen associated with ore mineral. Exception observed at Vein Zone, Cerro Negro, Patagonia



- ◆ Mixing - important association with carbonate, particularly manganese carbonate

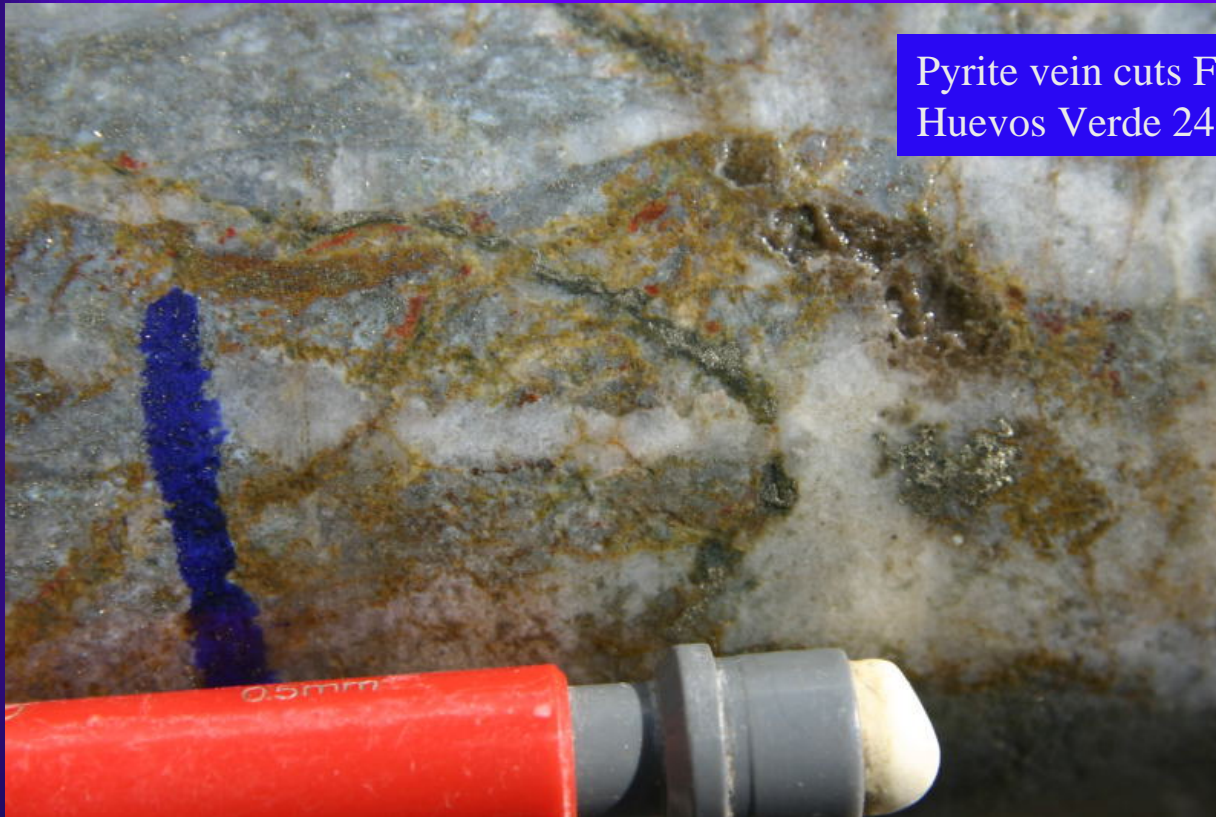
Rhodocrosite
underground Caylloma



Calcite associated with
base metal sulphide in
core, Huevos Verdes



Mixing with oxygenated waters – hypogene haematite, jarosite



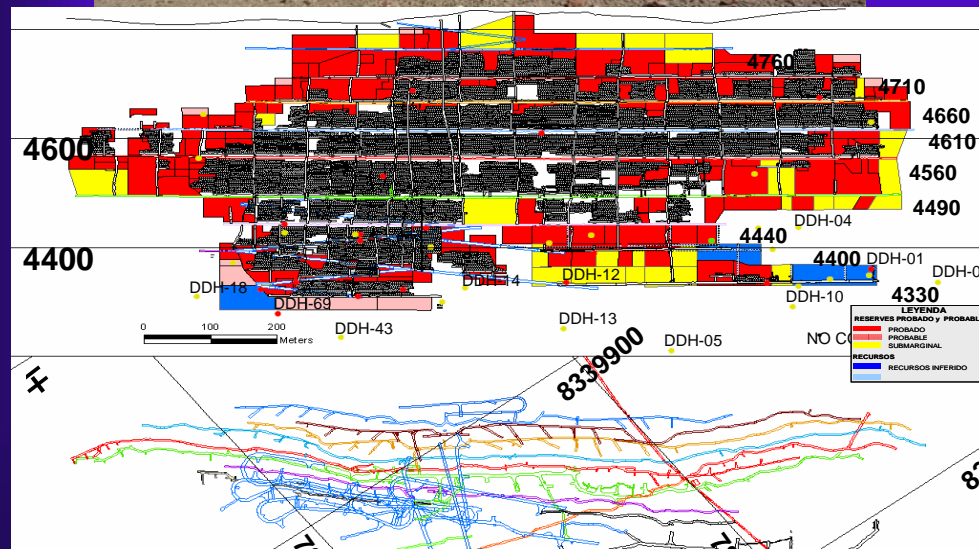
Pyrite vein cuts FeO 150m below redox boundary
Huevos Verde 24.6 g/t Au, 4250 /t Ag

- ◆ Mixing of fluids such as acid solution collapse
 - Arcata mine, Tres Reyes,

Hypogene kaolin, Huevos Verdes, Patagonia



Huevos Verde vein sample, multi ounce gold-silver



Mn Oxide a potentially important guide

Manganese oxide in
vein outcrop, Arcata,
Peru



Conclusion – Polymetallic Au-Ag low sulphidation epithermal

- ◆ Common sulphide gangue assemblage: pyrite, sphalerite, galena, chalcopyrite, Ag sulphosalts with quartz, carbonate, barite gangue
- ◆ Important discoveries still to be made (for example Palmarejo, Mexico)
- ◆ Vertically zonation:
 - High level: Au-Ag with argentite and Ag sulphosalts
 - Central: Ag-Au with pyrite-galena-sphalerite
 - Deep: Au > Ag chalcopyrite in early quartz-sulphide
- ◆ Mineralization controls factors such as: host rock competency, dilational structure, vertical zonation and mechanism of Au-Ag deposition

An exceptionally useful, practical model for field geologists to carry around in their head whilst prospecting!!

