Silver Exploration in Mexico
Status Report 2014

11º Seminario Internacional de Minería Sonora 2014, AIMMGM A.C.

by
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Resource Geosciences de Mexico SA de CV
22 October 2014
Conclusions

• Mexico is desirable location for silver exploration

• Exploration success and production from:
  1. LSE - low sulfidation epithermal deposits
  2. CRD - carbonate replacement deposits
  3. IRP - intrusive related polymetallic deposits
Conclusions

- Success coming from “new districts”
- Success coming from non-traditional sources
- Successful companies commit to drilling
- Exploration opportunities exist for aggressive explorationists willing to test concealed or conceptual targets
Sources of Information

All resource estimate and production information is obtained from public domain sources, including:

I. Company press releases and annual reports
II. Public company regulatory filings (SEDAR, EDGAR)
III. Servicio Geologico de Mexico
IV. INEGI
V. USBM

Information is believed to be accurate but has not been independently confirmed by the author!
Why should we explore for silver in Mexico?
Because it’s where the silver is!

> 10 B oz Ag production
## Top 15 Silver Producing Countries in 2013

(millions of ounces Ag)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mexico</td>
<td>169.7</td>
</tr>
<tr>
<td>2.</td>
<td>Peru</td>
<td>118.1</td>
</tr>
<tr>
<td>3.</td>
<td>China</td>
<td>118.0</td>
</tr>
<tr>
<td>4.</td>
<td>Australia</td>
<td>59.2</td>
</tr>
<tr>
<td>5.</td>
<td>Russia</td>
<td>45.4</td>
</tr>
<tr>
<td>6.</td>
<td>Bolivia</td>
<td>41.2</td>
</tr>
<tr>
<td>7.</td>
<td>Chile</td>
<td>39.2</td>
</tr>
<tr>
<td>8.</td>
<td>Poland</td>
<td>37.6</td>
</tr>
<tr>
<td>9.</td>
<td>United States</td>
<td>35.0</td>
</tr>
<tr>
<td>10.</td>
<td>Argentina</td>
<td>24.7</td>
</tr>
<tr>
<td>11.</td>
<td>Canada</td>
<td>20.8</td>
</tr>
<tr>
<td>12.</td>
<td>Kazakhstan</td>
<td>19.8</td>
</tr>
<tr>
<td>13.</td>
<td>India</td>
<td>12.1</td>
</tr>
<tr>
<td>14.</td>
<td>Sweden</td>
<td>10.8</td>
</tr>
<tr>
<td>15.</td>
<td>Guatemala</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Source: The Silver Institute

www.silverinstitute.org

statistics adapted in part from the Silver Institute’s World Silver Survey 2014 publication.
**Top 15 Primary Silver Producing Mines in 2013**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Mine Name</th>
<th>Country</th>
<th>Company Name</th>
<th>Silver Produced (M Oz. Ag)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cannington¹</td>
<td>Australia</td>
<td>BHP Billiton plc.</td>
<td>29.09</td>
</tr>
<tr>
<td>2</td>
<td>Fresnillo Mine, Mexico</td>
<td>Mexico</td>
<td>Fresnillo</td>
<td>22.76</td>
</tr>
<tr>
<td>3</td>
<td>Dukat²</td>
<td>Russia</td>
<td>Polymetal Intnl</td>
<td>18.30</td>
</tr>
<tr>
<td>4</td>
<td>Saucito, Mexico</td>
<td>Mexico</td>
<td>Fresnillo</td>
<td>11.58</td>
</tr>
<tr>
<td>5</td>
<td>Uchucchacua, Peru</td>
<td>Peru</td>
<td>Buenaventura.</td>
<td>11.44</td>
</tr>
<tr>
<td>6</td>
<td>Pirquitas, Argentina</td>
<td>Argentina</td>
<td>Silver Standard</td>
<td>8.22</td>
</tr>
<tr>
<td>7</td>
<td>Pallancata, Peru</td>
<td>Peru</td>
<td>Hochschild.</td>
<td>7.63</td>
</tr>
<tr>
<td>8</td>
<td>Palmarejo, Mexico</td>
<td>Mexico</td>
<td>Coeur Mining</td>
<td>7.60</td>
</tr>
<tr>
<td>9</td>
<td>Greens Creek, U.S.</td>
<td>U.S.</td>
<td>Hecla Mining</td>
<td>7.45</td>
</tr>
<tr>
<td>10</td>
<td>San José, Argentina</td>
<td>Argentina</td>
<td>Hochschilden</td>
<td>6.36</td>
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<tr>
<td>11</td>
<td>Imiter³</td>
<td>Morocco</td>
<td>Soc.Mét. d’Imiter</td>
<td>6.24</td>
</tr>
<tr>
<td>12</td>
<td>San Bartolomé, Bolivia</td>
<td>Bolivia</td>
<td>Coeur Mining</td>
<td>5.94</td>
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<tr>
<td>13</td>
<td>Alamo Dorado, Mexico</td>
<td>Mexico</td>
<td>Pan American</td>
<td>5.04</td>
</tr>
<tr>
<td>14</td>
<td>Gümüsköy³</td>
<td>Turkey</td>
<td>Eti Gümüş</td>
<td>5.00</td>
</tr>
<tr>
<td>15</td>
<td>Arcata, Peru</td>
<td>Peru</td>
<td>Hochschild</td>
<td>4.98</td>
</tr>
</tbody>
</table>

(Source: Silver Institute’s World Silver Survey 2014 publication)
What’s happened in the last 10 years?

Tremendous exploration success
What’s happened in the last 10 years?

– More production
  • 2X increase production
Production Boom

Mexico Ag Production

- Year: 2000 to 2013
- M ounces Ag produced: 84 to 174
- Mexico annual silver production, M Oz.

Graph showing the increase in Mexico's silver production from 2000 to 2013.
What’s happened in the last 10 years?

– More production
  • 2X increase production

– More discoveries and more silver
  • 3.5X increase in silver resources in development projects
# 2004 Mexico Development Projects

(Silver Resource plus Reserve, Prov and Prob, M & I)

<table>
<thead>
<tr>
<th>Project</th>
<th>Owner</th>
<th>M oz. Ag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peñasquito, Zac</td>
<td>Western Silver</td>
<td>274</td>
</tr>
<tr>
<td>Palmarejo, Chih</td>
<td>Bolnisi</td>
<td>126</td>
</tr>
<tr>
<td>Dolores, Chih</td>
<td>Minefinders</td>
<td>123</td>
</tr>
<tr>
<td>Ocampo, Chih</td>
<td>Gammon Lake</td>
<td>77</td>
</tr>
<tr>
<td>Alamo Dorado, Son</td>
<td>PanAmerican Silver</td>
<td>77</td>
</tr>
<tr>
<td>Pitarilla, Dgo</td>
<td>Silver Standard</td>
<td>60</td>
</tr>
<tr>
<td>Monterde, Chih</td>
<td>Kimber</td>
<td>27</td>
</tr>
<tr>
<td>Topia, Dgo</td>
<td>Great Panther</td>
<td></td>
</tr>
<tr>
<td>Platosa, Dgo</td>
<td>Excellon</td>
<td></td>
</tr>
</tbody>
</table>

*Total* 764
### 2004 Mexico Development Projects (now operating mines)

<table>
<thead>
<tr>
<th>Project</th>
<th>Owner</th>
<th>M oz. Ag</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peñasquito, Zac</strong></td>
<td>GoldCorp</td>
<td>22</td>
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<tr>
<td><strong>Palmarejo, Chih</strong></td>
<td>Coeur</td>
<td>8</td>
</tr>
<tr>
<td><strong>Dolores, Chih</strong></td>
<td>Pan American Silver</td>
<td>4</td>
</tr>
<tr>
<td><strong>Ocampo, Chih</strong></td>
<td>Frisco</td>
<td>4</td>
</tr>
<tr>
<td><strong>Alamo Dorado, Son</strong></td>
<td>PanAmerican Silver</td>
<td>5</td>
</tr>
<tr>
<td><strong>Topia, Dgo</strong></td>
<td>Great Panther</td>
<td>1</td>
</tr>
<tr>
<td><strong>Platosa, Dgo</strong></td>
<td>Excellon</td>
<td>1</td>
</tr>
</tbody>
</table>
## 2014 Mexico Development Projects
*(Silver Resource plus Reserve, Prov and Prob, M & I)*

<table>
<thead>
<tr>
<th>Property</th>
<th>Company</th>
<th>State</th>
<th>M Oz Ag</th>
<th>Grade gpt Ag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metates</td>
<td>Chesapeake</td>
<td>Durango</td>
<td>526</td>
<td>14</td>
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<tr>
<td>Cordero</td>
<td>Levon</td>
<td>Chihuahua</td>
<td>489</td>
<td>21</td>
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<tr>
<td>Pitarilla</td>
<td>Silver Std</td>
<td>Durango</td>
<td>479</td>
<td>95</td>
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<td>San Julian</td>
<td>Fresnillo</td>
<td>Chihuahua</td>
<td>201</td>
<td>?</td>
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<tr>
<td>Saucito II</td>
<td>Fresnillo</td>
<td>Zacatecas</td>
<td>180</td>
<td>?</td>
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<tr>
<td>La Preciosa</td>
<td>Coeur</td>
<td>Durango</td>
<td>175</td>
<td>95</td>
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<tr>
<td>Juanicipio</td>
<td>MAG/Fresnillo</td>
<td>Zacatecas</td>
<td>160</td>
<td>601</td>
</tr>
</tbody>
</table>
## 2014 Mexico Development Projects
**(Silver Resource plus Reserve, Prov and Prob, M & I)**

<table>
<thead>
<tr>
<th>Property</th>
<th>Company</th>
<th>State</th>
<th>M Oz Ag</th>
<th>Grade gpt Ag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ixtaca</td>
<td>Almaden</td>
<td>Puebla</td>
<td>97</td>
<td>36</td>
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<tr>
<td>Camino Rojo</td>
<td>GoldCorp</td>
<td>Zacatecas</td>
<td>57</td>
<td>10</td>
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<tr>
<td>San Miguel</td>
<td>Paramount</td>
<td>Chihuahua</td>
<td>54</td>
<td>70</td>
</tr>
<tr>
<td>Nieves</td>
<td>Quaterra</td>
<td>Zacatecas</td>
<td>53</td>
<td>50</td>
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<tr>
<td>La Cigarra</td>
<td>Intnl Northair</td>
<td>Chihuahua</td>
<td>50</td>
<td>76</td>
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<tr>
<td>San Agustin</td>
<td>Argonaut</td>
<td>Durango</td>
<td>48</td>
<td>16</td>
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<tr>
<td>Promontorio</td>
<td>Kootenay</td>
<td>Sonora</td>
<td>40</td>
<td>28</td>
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<tr>
<td>Monterde</td>
<td>Invecture</td>
<td>Chihuahua</td>
<td>39</td>
<td>60</td>
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<tr>
<td>Cerro de Gallo</td>
<td>Primero</td>
<td>Guanajuato</td>
<td>36</td>
<td>14</td>
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<td>San Jose</td>
<td>Arian Silver</td>
<td>Zacatecas</td>
<td>31</td>
<td>119</td>
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<td>San Jose</td>
<td>Fortuna Silver</td>
<td>Oaxaca</td>
<td>21</td>
<td>225</td>
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<td>San Sebastian</td>
<td>Hecla</td>
<td>Durango</td>
<td>13</td>
<td>205</td>
</tr>
</tbody>
</table>

**Total** 2750
What’s happened in the last 10 years?

Exploration boom

• Exploration peaked in 2011-2012
What’s happened in the last 10 years?

Exploration bust

- In 2014 only ~30 companies actively exploring
- Depressed metal prices and lack of financing
- Changes in Mexican tax policy harmful, but not principal cause
Silver price trend superimposed on production trend
Who is exploring for Ag in Mexico?

Producing Companies
- Fresnillo
- Coeur Mining
- Hecla
- Great Panther
- Pan American
- Silver Standard
- First Majestic
- Endeavor Silver
- Excellon
- Fortuna Silver
- Santacruz Silver
- Silvercrest
Who is exploring for Ag in Mexico?

Exploration Companies

– Kootenay
– Paramount
– Quaterra
– International Northair
– Soltoro
– Arian Silver
– Orex
– Plata Latina
– Prospero Silver
– Canasil
– Defiance Silver
Before we look to the future, a quick look at the past

History

Where has the silver come from?
History

- Pachuca > 1,300 M oz.
- Guanajuato > 1,000 M oz.
- Zacatecas > 800 M oz.
- San Dimas > 650 M oz.
- Fresnillo > 600 M oz.
- Parral/Sta Barbara/San Fco > 500 M oz.
- Santa Eulalia > 400 M oz.
- Batopilas > 300 M oz.
- Taxco > 300 M oz.
- Concepcion del Oro > 250 M oz.
- Real de Catorce > 200 M oz.
- Real de Angeles > 200 M oz.
History

• Pachuca > 1,300 M oz.
• Guanajuato > 1,000 M oz.
• Zacatecas > 800 M oz.
• San Dimas > 650 M oz.
• **Fresnillo** > 600 M oz.
• Parral/Sta Barbara/San Fco > 500 M oz.
• Santa Eulalia > 400 M oz.
• Batopilas > 300 M oz.
• Taxco > 300 M oz.
• Concepcion del Oro > 250 M oz.
• Real de Catorce > 200 M oz.
• Real de Angeles > 200 M oz.
Major Mexico Silver Districts

Historic production, major silver districts

- 200 - 300
- 301 - 600
- 601 - 800
- 801 - 1300
Current Events

Where is the silver coming from today?
10 largest 2013 Ag producers
10 largest 2013 Ag producers
10 largest 2013 Ag producers

- Peñasquito 22M Oz
- Fresnillo 22M Oz
- Saucito 11M Oz
- Palmarejo 8M Oz
- Tayoltita 6M Oz
- Tizapa 5M Oz
- Alamo Dorado 5M Oz
- La Colorada 5M Oz
- La Encantada 4M Oz
- Sabinas 4M Oz
10 largest 2013 Ag producers

Peñasquito 22M Oz
Fresnillo 22M Oz
Saucito 11M Oz
Palmarejo 8M Oz
Tayoltita 6M Oz
Tizapa 5M Oz
Alamo Dorado 5M Oz
La Colorada 5M Oz
La Encantada 4M Oz
Sabinas 4M Oz
10 largest 2013 Ag producers

Only 3 of the most productive silver mines are in the historic silver districts.
The future

Where will the silver be coming from in 2024?

From “new districts” and from deposit types that historically have not been major silver producers.
“New districts”
Ag resources, 2013

Ag resources, M oz

- 10 - 50
- 51 - 200
- 201 - 400
- 401 - 600
Ag resources, 2013

Map showing silver resources in Mexico in 2013.
Ag resources, 2013

New silver resources being developed outside of historic districts
Ag resources, 2013

New silver resources being developed outside of historic districts and away from active mines.

Ag resources, M oz
- ▲ 10 - 50
- ▲ 51 - 200
- ▲ 201 - 400
- ▲ 401 - 600
Non-traditional deposit types
Ag Exploration in Mexico Directed at Three Important Ag Deposit Types*

1. LSE - Low sulfidation epithermal **(vein and stockwork/disseminated)
   – Example: Fresnillo

2. CRD – Carbonate replacement deposit, polymetallic
   – Example: Santa Eulalia

3. IRP - Intrusive related polymetallic, direct spatial and/or genetic link to intrusives
   – Example: Peñasquito

Note: LSE and CRD also related to intrusives, but IRP’s distinguished by direct association

* Not genetic classifications! Based on basic economic characteristics!
** Includes “intermediate sulfidation” systems as per Hedenquist classifications.
Non-traditional deposit types

IRP deposits will become increasingly important producers of silver
Major Ag mines, 2013

Current silver production from a variety of deposit types
Major Ag mines, 2013

Current silver production from a variety of deposit types

Ag mines, deposit type
- CRD
- CRD?
- IRP
- LSE
- VMS
Major Ag resources, 2013

Future silver production from IRP and LSE deposit types

Ag resources, deposit type
- IRP
- IRP?
- LSE
- LSE?
Major Ag resources, 2013

Future silver production from IRP and LSE deposit types
What are companies looking for?

1. **LSE - Low sulfidation epithermal (vein and stockwork/disseminated)**
   - Most productive deposit type historically
   - Ag/Au and Ag/Pb/Zn systems, but high grade systems can stand alone economically on Ag content
   - Best bet for a high grade primary Ag producer

   - Juanicipio/Valdecañas: 601 gpt Ag
   - Saucito: 384 gpt Ag
   - Fresnillo: 271 gpt Ag
What are companies looking for?

2. CRD – carbonate replacement deposit

- Ag-Pb-Zn
- Can be high grade Ag, but typically co-product metals essential for positive economics

- La Platosa 553 gpt Ag
- La Encantada 227 gpt Ag
What are companies looking for?

3. IRP - Intrusive related polymetallic
   - Polymetallic systems, Ag-Au-Pb-Zn
   - Large scale, >100 M tonnes
   - Low grade
   - Enormous Ag resources due to their large size, but Ag is normally a co-product

   - Peñasquito  605 M oz Ag @ 30 gpt
   - Metates      526 M oz Ag @ 14 gpt
   - Cordero      489 M oz Ag @ 21 gpt
   - Pitarilla    479 M oz Ag @ 95 gpt
Where are companies looking?
Silver deposits and geology
Silver deposits and geology

Sierra Madre Occidental
Silver deposits and geology

J-K shallow marine seds (Chihuahua and Coahuila Terranes, “Mexico Geosyncline”, and fold/thrust belt,)

Sierra Madre Occidental
Silver deposits and geology

J-K shallow marine seds (Chihuahua and Coahuila Terranes, “Mexico Geosyncline”, and fold/thrust belt,)

Altiplano

Sierra Madre Occidental
Silver deposits and geology

J-K shallow marine seds (Chihuahua and Coahuila Terranes, “Mexico Geosyncline”, and fold/thrust belt,)

Altiplano

Sierra Madre Occidental

Trans Mexican Volcanic Belt
Silver deposits and geology
Silver deposits and geology

Deposit Type
- CRD
- CRD?
- IRP
- LSE
- VMS
Observation

1. Direct discovery in outcrop still possible in underexplored areas
   - Ixtaca, Puebla (Almaden)
   - Promontorio/La Negra, Sonora (Kootenay)
Observation

2. If system is exposed in outcrop, significance might not be easily recognized.
   – Ore bearing portion possibly concealed
   – “uninteresting narrow structures” may reflect significant Ag deposits at depth
Observation

3. Concealed systems provide no direct surface evidence
   – San Sebastian, Durango demonstrates potential for discoveries in areas without any historical precedent of mining/exploration
   – about 3m away from being completely blind
4. Large productive systems may have small and subtle footprints
   - Some systems have extensive high level alteration zones, but many exposed productive LSE and CRD systems lack extensive surface hydrothermal alteration, thus no color anomaly or widespread alteration
I’m standing in the midst of 1 billion ounces of silver. Where is the color anomaly?
He is standing on the vein. Where is the alteration halo?
Observation

5. Surface geochem cannot directly identify blind or deep targets
   – Blind CRD orebodies notoriously difficult to find using geochem
   – LSE barren zones are truly barren of metals of interest
   – Surface expression of productive LSE system may yield only a weak pathfinder Hg anomaly
Exploration Considerations in Mexican Deep Boiling Systems

Information from Albinson et al., 2001, Buchanon, 1981
Exploration Considerations in Mexican Deep Boiling Systems

Information from Albinson et al. 2001, Buchanon, 1981

alteration tightly restricted to structure
no Au or Ag anomaly, possible Hg anomaly

Resource Geosciences de Mexico SA de CV
11º Seminario Internacional de Minería, Sonora 2014, AIMMGM A.C., 22 October 2014
Exploration Implications

Evaluation of Prospect

• Grade at surface not a make-or-break factor
• Seek indications of level of exposure
• Extent of mineralizing system
  — Showings dispersed over wide zone or localized on a single structure?
• Evidence of dynamic HT system?
  — HT breccias, cross cutting veins, etc.
Exploration Implications

Must drill!

- In mature districts, outcropping ore will not be found today, therefore must drill within favorable system
Exploration Implications

Must drill!

• This is common sense, but many exploration companies forget this rule, (or can’t afford to respect it!) leaving opportunities for others
Exploration Implications

**Must drill!**
- LSE and CRD systems are not tested with small drill programs
- Drilling a discovery hole at the outset is extremely unlikely
- The first drill campaign provides the information needed to understand zoning and vectors in the system
The good news

New discoveries are waiting to be made!
The bad news

Won’t happen anytime soon!
The bad news

Requires large drill budgets – hard to obtain for most explorers in today’s financial environment.

• A few drillholes in a complex target will almost certainly fail, so must commit to an adequate drill test, or money spent drilling is a mis-use of exploration budget.

• Successful companies understand this – is it a coincidence that Fresnillo PLC, the world’s largest silver producer, commits $100M US annually to drilling?
Conclusions

• Mexico is geologically, politically, and logistically desirable location for silver exploration investment
• Exploration successes with LSE, CRD, and IRP deposits
• Successful exploration requires commitment to drill
• Opportunities exist for aggressive (well funded) explorationists
Gracias a todos por su atención.
Gracias a todos por su atención.