Structural Setting and Metal Zoning of the Gold-Silver Veins Real de Minas de Zacualpan District, Central Mexico

Brian V. Hall, George A. Gorzynski, Nigel J. Hulme, Alberto R. Vila-Sánchez, Roberto Díaz-Martínez, Carlos Cham-Domingez, Federico Limón Gallegos, Jose Luis Aldana and Wojtek Jakubowski
WHAT THIS TALK WILL REALLY COVER

• HISTORICAL ASPECTS OF THE ROYAL MINES OF ZACUALPAN DISTRICT

• DISTRICT SCALE STRUCTURAL FEATURES

• GEOLOGICAL FACTORS AFFECTING THE DISTRIBUTION OF SILVER AND GOLD WITHIN THE ZACUALPAN DISTRICT

• PRELIMINARY OBSERVATIONS AND CONCLUSIONS CONCERNING A DYNAMIC MODEL FOR THE EMPLACEMENT OF THE GOLD – SILVER VEINING
A GOOGLE SEARCH FOR “SILVER, MEXICO”

**Taxco Silver Capital** of Mexico - **Taxco** City Guide - **Taxco** Tourist ...
**Taxco** is the place to buy silver in Mexico. It's also a picturesque colonial town with winding cobblestone streets and white-washed houses. gomexico.about.com/od/colonialcities/p/taxco.htm - 22k

Welcome to ShoreTrips® - TRAVEL TO **TAXCO** – THE **SILVER CAPITAL** OF ...
Acapulco shore excursions and activities by Shoretrips. We test all our Acapulco shore excursions and activities before we list them on our site so we know ...
...www.shoretrips.com/common/search4.asp?tcode=006254 - 30k -

**Silver Jewelry From** **Taxco** Mexico's **Silver Capital**
**Taxco** which is pronounced Tahs-ko, itself is located in the hills between Acapulco and Mexico City and is a city with a natural ambiance and charm with its www.articlesbase.com/jewelry-articles/silver-jewelry-from-taxco-mexico-silver-capital-610465.html - 56k - Cached - Similar pages

Pilot Guides.com: **Silver capital** of the world: **Taxco**
Not only has **Taxco** been declared a National Historical Monument, but it’s also widely regarded as the **silver capital** of the world. There are 6 working mines ...
www.pilotguides.com/destination_guide/north_america/mexico/taxco_silver.php - 31k -

**Taxco**, the **silver capital** of Mexico - a set on Flickr
Flickr is almost certainly the best online photo management and sharing application in the world. Show off your favorite photos and videos to the world, ...
www.flickr.com/photos/myrmardan/set/72157594397833711/ - 29k - Cached - Similar pages

YouTube - The **Silver Capital**, Tasco, Taxco Mexico
the biggest **silver capital** in the world. ... is just not even trying for a lady on TV! **Taxco** is gorgeous!
ZACUALPAN DISTRICT LOCATION MAP

Epithermal Silver Belt
Pre-Hispanic Mining Centers in Latin America

(From Cathro, R. J., 2000)
REGIONAL GEOLOGY

Cuernavaca Geology Mapsheet E4-6 (Rivera C.E., De La Teja S. M.A., Miranda H., A., Lemus B. O., and Motolinia G. O.)
ZACUALPAN DISTRICT VEIN MEASUREMENTS

VEIN AZIMUTH (strike direction)
- 1 - 25 (East Dip)
- 26 - 90 (South East Dip)
- 91 - 165 (South West Dip)
- 166 - 190 (West Dip)
- 191 - 270 (West Dip)
- 271 - 340 (North East Dip)
- 341 - 360 (East Dip)

NUMBER OF VEIN MEASUREMENTS
22,506
ZACUALPAN DISTRICT

TYPES OF SILVER – GOLD VEINS

Epithermal Silver-Lead-Zinc Vein

Mesothermal Gold-Copper-Arsenic Vein
ZACUALPAN VEINS Au – Ag ZONING

NUMBER OF VEINS
587

Meters
0 1,250 2,500 5,000 7,500 10,000

PRECIOUS METAL CONTENT
- Principally Silver
- Silver with Gold
- Principally Gold
- Gold with Silver
FACTORS AFFECTING THE DISTRIBUTION OF THE SILVER – GOLD VEINS

- A general bias toward the N-S Veins having a higher gold content, which in turn occupy structures having a vertical sense of displacement ("normal faults"), and are deeper rooted.

- Different types of structures contain different metal contents with the extensional structures having deeper channel ways, which in turn are enriched in gold contents due to higher temperature solutions.

- Present topography does not appear to be significant.

- Depth of emplacement for the veins is important (paleotopography).

- The presence of Dacite Intrusions of the Tilzapola Formation is very important!

- A regional progression from SW to NE of Mesothermal Geochemistry (Au-As-Cu) to Epithermal Geochemistry (Ag-Sb-Mn) suggesting an overall tilt to the district is perhaps the most important factor.
SOIL GEOCHEMISTRY

Progression from Mesothermal to Epithermal

Arsenic

Copper

Antimony

Manganese

N = 85,854

N = 85,854

N = 85,854

N = 85,854
SOIL GEOCHEMISTRY

TILTING OF ZACUALPAN DISTRICT

Gold

Silver

N = 67,309

N = 85,854
ZACUALPAN DISTRICT – METAL ZONING

GOLD – SILVER RATIOS IN VEINS

GOLD - SILVER RATIO
Gold (g/t) x (100) / Silver (g/t)
0.0 - 1.0
1.0 - 5.0
5.0 - 10.0
10.0 - 20.0
20.0 - 50.0
50.0 - 100.0
100.0 - 50,000.0

OLIGOCENE TILZAPOLTA FORMATION

GOLD - SILVER RATIO
Gold (g/t) x (100) / Silver (g/t)
0.0 - 1.0
1.0 - 5.0
5.0 - 10.0
10.0 - 25.0
25.0 - 50.0
50.0 - 100.0
100.0 - 50,000.0

DETAILED MAP SHOWING
AREA OF FELSIC INTRUSIVES
CARLOS PACHECO VEIN
STRUCTURAL SETTING & METAL ZONING

CARLOS PACHECO VEIN - LONG SECTION
LEAD (wt. percent)

CARLOS PACHECO VEIN - LONG SECTION
COPPER (wt. percent)

ROCK SAMPLE VALUES

<table>
<thead>
<tr>
<th>Silver (pt)</th>
<th>Gold (pt)</th>
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</thead>
<tbody>
<tr>
<td>&lt; 30.0</td>
<td>&lt; 0.02</td>
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<tr>
<td>30.1 - 60.0</td>
<td>0.021 - 1.002</td>
</tr>
<tr>
<td>60.1 - 150.0</td>
<td>1.001 - 2.500</td>
</tr>
<tr>
<td>150.1 - 300.0</td>
<td>2.501 - 5.000</td>
</tr>
<tr>
<td>300.1 - 600.0</td>
<td>5.001 - 10.000</td>
</tr>
<tr>
<td>&gt; 600.0</td>
<td>&gt; 10.000</td>
</tr>
</tbody>
</table>

SW
NOCHEBUENA / CARLOS PACHECO
CROSS SECTION 12+50 N

NE
ZACUALPAN DISTRICT

IMPORTANT MINES - DILATIONAL JOG STRUCTURES

Number of Old Mine & Explorations Workings
3,876 as of October 1, 2014

CARLOS PACHECO
KENA
PROGRESO
CHIVO
COMETA
NOCHE BUENA
SAN ADRIAN
SAN MARGARITO
Mamatla
Zacualpan
XITINGA
POZO HONDA
DISTRICT SCALE OBSERVATIONS

THE NORTH-SOUTH STRIKING VEINS HAVE A VERTICAL SENSE OF DISPLACEMENT

THE NORTHWEST STRIKING (NE DIPPING) VEINS TEND TO HAVE A LATERAL SENSE OF DISPLACEMENT

THE NORTHWEST STRIKING (SW DIPPING) VEINS TEND TO HAVE A VERTICAL SENSE OF DISPLACEMENT

WITH THE OVERALL STRESS REGIME BEING “TRANSPRESSIONAL SHEAR”
## ZACUALPAN DISTRICT VEINS

### STRUCTURAL SETTING OF VEINS

<table>
<thead>
<tr>
<th>Type 1 - Transpressional Shear</th>
<th>Type 2 - Dilational Jog</th>
<th>Type 3 - Thrust Fault</th>
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<tbody>
<tr>
<td><strong>Strike Direction</strong></td>
<td><strong>Dip Direction</strong></td>
<td><strong>Structural Style</strong></td>
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<tr>
<td>NW</td>
<td>NE</td>
<td>Angular Compression</td>
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<tr>
<td><strong>MINE NAME</strong></td>
<td><strong>AREA</strong></td>
<td><strong>VEIN NAME</strong></td>
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<tr>
<td>Cuchara</td>
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<td>Cuchara</td>
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<tr>
<td>El Moro</td>
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<td>Los Reyes</td>
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<td>Golondrinas</td>
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<td>La Condesa</td>
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</tr>
<tr>
<td>El Moral</td>
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<td>El Moral</td>
</tr>
</tbody>
</table>

### Central Zacualpan District Map

The map shows the distribution of veins and structural features within the Zacualpan District, highlighting the structural setting of veins and the direction of movement associated with each structural style.
Poster Session
Geologic Maps and Their Derivatives
Tuesday October 21st 9:00 – 6:00
VCC–West, Exhibition Hall C

www.impactsilver.com/s/Presentations.asp