

Special report
Mining clusters in
Mexico

Guest opinion
Camimex

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PRO **México**

**THE UPWARD
TREND
OF MEXICAN
MINING**

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FROM PROMÉXICO



For more than five centuries, our country has been one of the leading producers and exporters of minerals in the world. Today the Mexican mining sector represents 5.5% of GDP. It is also the first link of the productive chain of many industries, and an important source of jobs: it generated close to 345,000 jobs in 2015.

Mexico occupies an important position as a global producer in this industry. The figures speak for themselves: our country is the worldwide number one producer of silver, number two of bismuth, number six of zinc, number seven of salt and number eight of gold, to name a few examples.

Besides being a major producer, our country is one of best destinations for mining investment. According to Behre Dolbear, our country ranks 5th among the best global destinations for investing in mining projects. Our

Canadian partners are the main investors in the Mexican industry, with 65% of the total, followed by the USA, with 17%.

Our country offers stability and growth perspectives in the long term thanks to its strategic geographical location, skilled workforce and world-class mineral deposits, as well as its competitive conditions in terms of costs, security, institutional strength and legal certainty.

This edition of *Negocios ProMéxico* presents an updated picture of the national mining industry and the investment and development opportunities that exist, especially with the participation of Mexico in the Trans-Pacific Partnership agreement, which will be a key factor in the development and growth of the companies and our country in general, as it will allow access to the world's largest economic bloc, with the benefits that this entails.

Welcome to *Negocios ProMéxico!*

Francisco N. González Díaz
CEO
ProMéxico

The Lifestyle

THE COMPLETE GUIDE
TO THE MEXICAN WAY OF LIFE

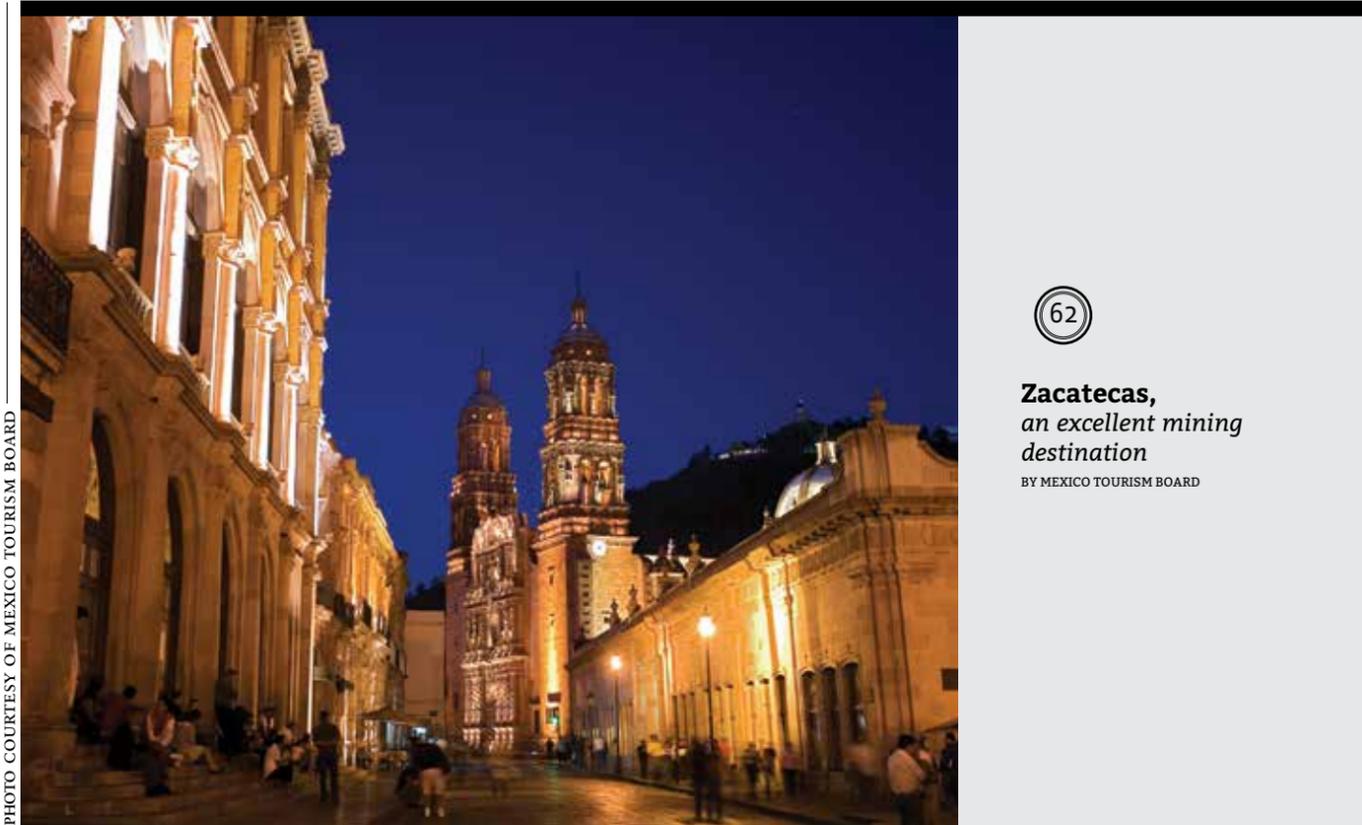


PHOTO COURTESY OF MEXICO TOURISM BOARD

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MEXICAN MINING A COMPETITIVE INDUSTRY

Prices of electricity, an important input of the cost structure of mining companies, dropped 26.8% for the industry between January of 2014 and December of 2015.

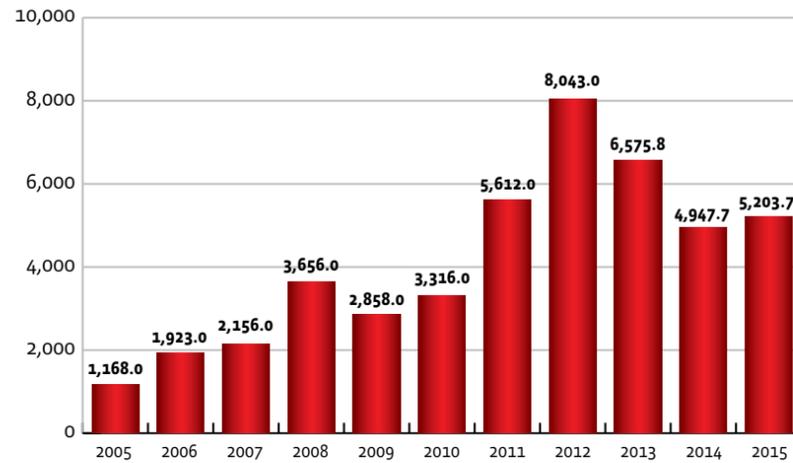
BY THE GENERAL DIRECTORATE OF MINING, GENERAL COORDINATION OF MINING, MINISTRY OF ECONOMY

Investment in the national mining sector reached 5.2 billion dollars in 2015, according to the Mining Chamber of Mexico (Camimex). This represents a 5.1% increase over 2014, and reverses the downward trend of the previous two years. Investments of almost 1.5 billion dollars in new projects stands out, a figure that represents an increase of 10% compared with the previous year.

Meanwhile, the value of mining-metallurgical production increased 6.5% in the January-November period of 2015 compared to the same period last year, driven mainly by a 16.8% growth in the value of precious minerals production. This was possible thanks to higher production volumes, which offset the price trend. Employment in the sector also recorded positive results. In December of 2015 the number of workers amounted to 344,912, a 1.2% increase over the previous year.

INVESTMENT IN THE MINING SECTOR

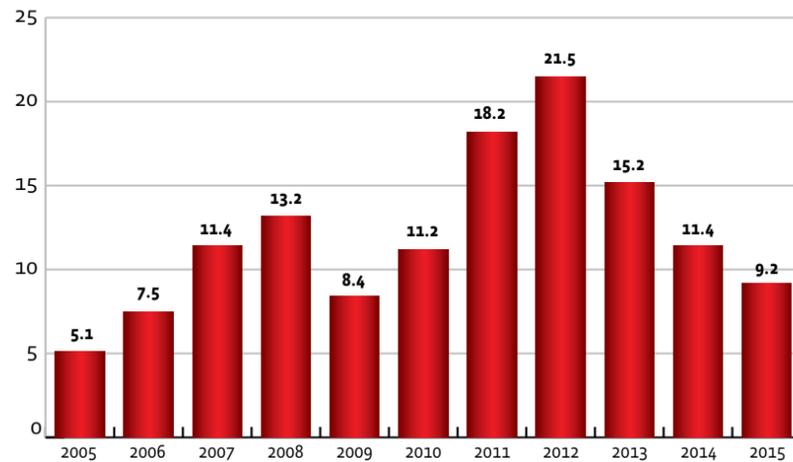
(MILLIONS OF DOLLARS)



Source: Camimex. Estimated data for 2015

WORLD INVESTMENT IN EXPLORATION

(BILLIONS OF DOLLARS)



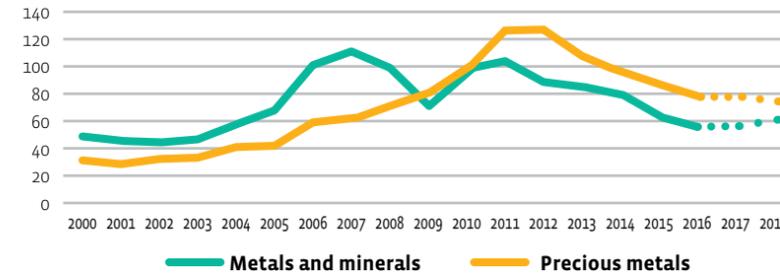
Source: Metals Economics Group and SNL Metals and Mining, several years

These results were nevertheless achieved in the reference year of a four-year cycle downward phase of mineral prices. Between 2012 and 2015, the prices of precious metals decreased 31.4%, while base metals descended 39.2%. The fall in prices has affected companies in the sector, mining industries all over the world, and even the dynamics of economies that depend on exports of raw materials.

Among the most important consequences resulting from the difficulties in the mining industry is the decline in investment. According to SNL Metals and Mining, exploration investment in the global mining sector declined for the third consecutive year, reaching a level of 9.2 billion dollars in 2015, 19.3% less than the previous year and the lowest indicator in the past six years. There have also been mine closures, projects have been postponed and there has been a wave of mergers and acquisitions.

PRICE INDEX*

(2010=100)

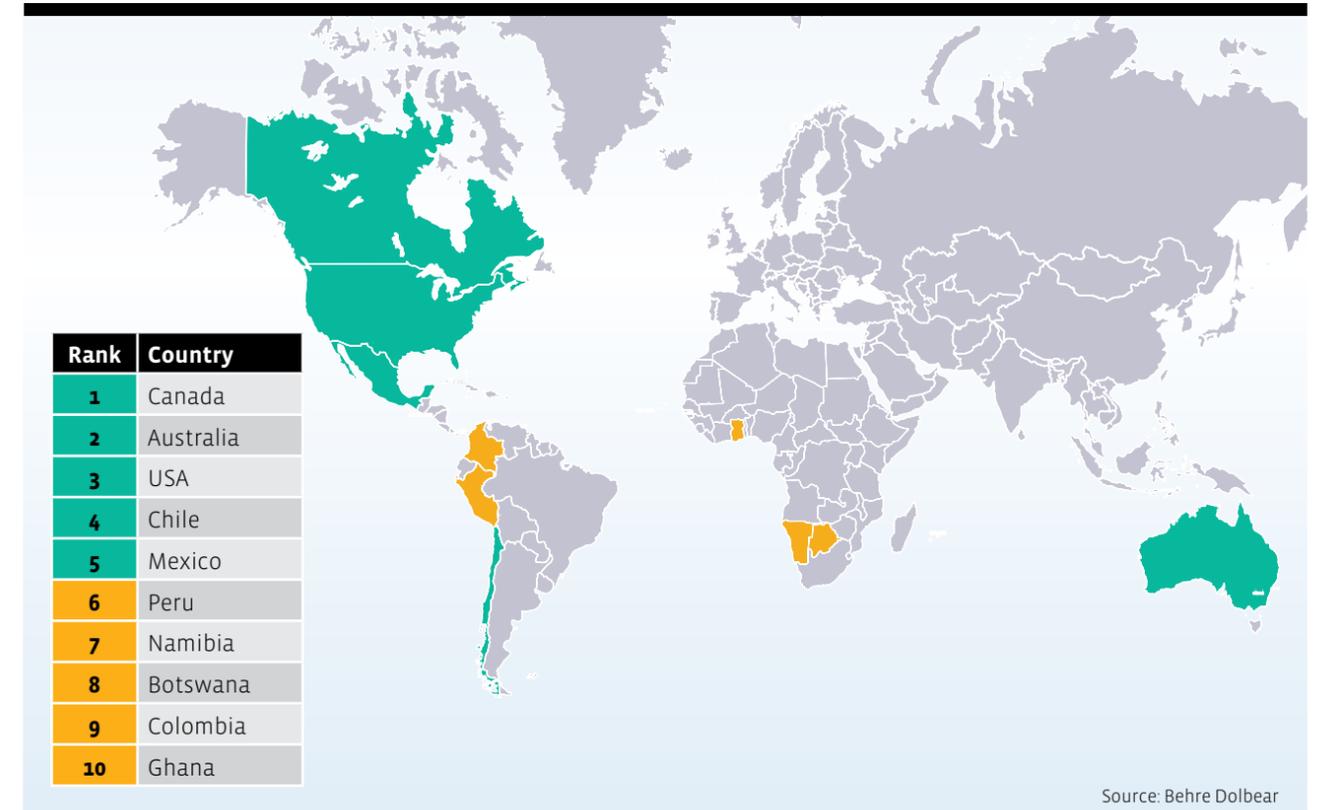


*Annual indices, 2010=100, 1960 to present, real 2005 US dollars. Source: World Bank, 2016

The World Bank estimates that the downward trend in prices will continue in 2016, and although some degree of recovery is forecast beginning in 2017, in the medium term it is not expected that prices will reach the levels they recorded in 2010 and 2011.

Mexico offers different options for developing successful businesses in the field of mineral resources. In December of 2015 there a was a total of 25, 531 mining concession titles in force in the country, which cover an area of 23.17 million hectares, equivalent to 11.8% of the national territory.

WHERE TO INVEST IN MINING 2015



Source: Behre Dolbear

COMPETITIVE EFFICIENCY IN MEXICAN MINING

Mexico provides competitive advantages in different aspects. In *Where to Invest 2015, Ranking of Countries for Mining Investment*, a study by the firm Behre Dolbear, our country appears once again as the 5th best destination for investing in mining, with a rating of 46.3, up from the 46 points scored one year earlier¹.

At the macroeconomic level, Mexico offers stability and prospects for long-term growth; in 2015 inflation in the national economy was 2.1%, below the target level set by the Banco de México (3%). And in terms of growth, according to the latest IMF forecasts, our country will grow at an average annual rate of 3.2% in the 2016-2020 period, a level above of what is expected for the Latin American region as a whole (2.2%), and above the growth rate expected for developed countries (2.1%).

Other great advantages that Mexico offers are competitive conditions in terms of costs. When considering a sample of 19 mines in operation in different countries,

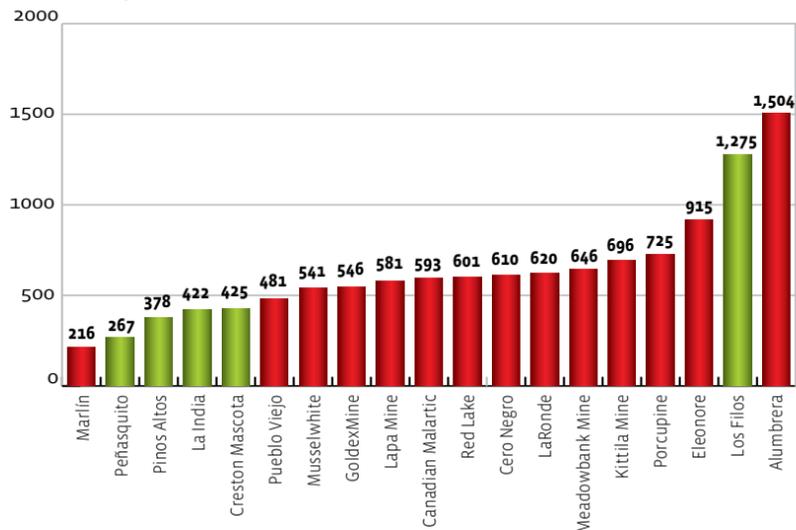
five of them in Mexico (see chart below), we can see that the majority of enterprises in our country—marked in green—are among the ones with the lowest costs, in terms of cash cost.

One relevant and influential result has been the reduction in prices of electricity,

One of the most important competitive advantages of the Mexican mining sector is its geological potential, as Mexico's mineral wealth is vast and varied.

CASH COST OF SELECTED MINES

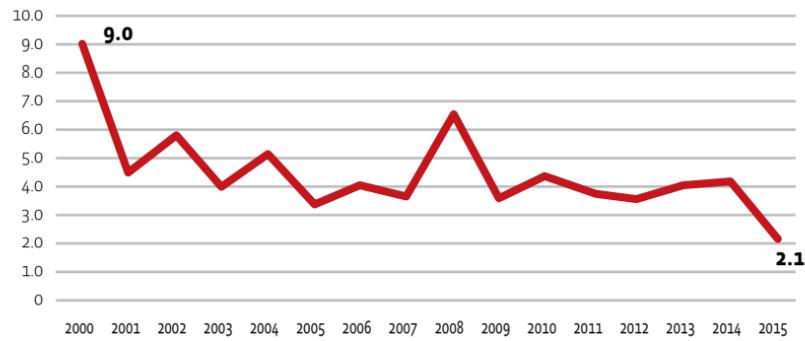
JANUARY-SEPTEMBER 2015 (DOLLAR/OUNCE OF GOLD)



Source: Quarterly Reports of Agnico Eagle and Goldcorp. Mines in green are located in Mexico

ANNUAL INFLATION

(PERCENTAGE VARIATION)



Source: INEGI.

an important input in the cost structure of mining companies. The average prices of energy rates were reduced 26.8% for the industrial sector between 2014 and 2015.

These circumstances allow mining companies to operate efficiently in our country, a factor that becomes crucial under the current market conditions and the competition to retain and gain space.

INVESTMENT OPPORTUNITIES IN MEXICAN MINING

One of the most important competitive advantages of the Mexican mining sector is its geological potential, as Mexico's mineral wealth is vast and varied. Currently, domestic production of leasable minerals includes 32 products, sixteen of which our country is among the top ten producers in the world.

Mexico offers different options for developing successful businesses in the field of mineral resources. In December of 2015 there was a total of 25,531 mining concession titles in force in the country, which cover an area of 23.17 million hectares, equivalent to 11.8% of the national territory. This means that there are ample opportunities for starting a mining business from the exploration phase by requesting a license, for which the mapping information provided by the Geological Mining Survey (GMS) is invaluable.

The geological-mining maps at scale 1:50,000 are key in identifying mineral exploration targets that constitute viable investment options. The development of

AVERAGE PRICE OF ELECTRICITY FOR THE INDUSTRY

(PESOS PER KILOWATT HOUR)



Source: Secretariat of Energy, 2016

this activity generates information for investors of the mining sector so that the evaluation of projects is facilitated and the exploration costs—the most significant pre-operating expenses—are reduced. By the end of 2015 the GMS recorded an accumulated advancement of 766,192 square kilometers of geological-mine mapping coverage at a scale of 1:50,000 in areas of mining interest.

There are also opportunities in the project exploration market that are being developed in several states, some of which require capitalization alternatives to consolidate and enter the next stages. Currently, 630 projects under exploration have been identified, with a wide range of minerals that contain gold, silver, copper, iron, lead, zinc, molybdenum and titanium, among others.

Another alternative is the General Directorate of Mining Development's Portfolio of Mining Projects, which includes 70 projects. This instrument provides investors with technical information on mining prospects, and gives owners of mining concessions the opportunity to promote them in order to detect business options.

A FUND FOR SUSTAINABLE REGIONAL DEVELOPMENT IN MINING STATES AND MUNICIPALITIES

The Tax Reform² included changes to the Federal Duties Law (FDL), with a Special Duty on Mining that applies a rate of 7.5% on earnings; an Additional Duty on Mining, that consists of a 50% increase on

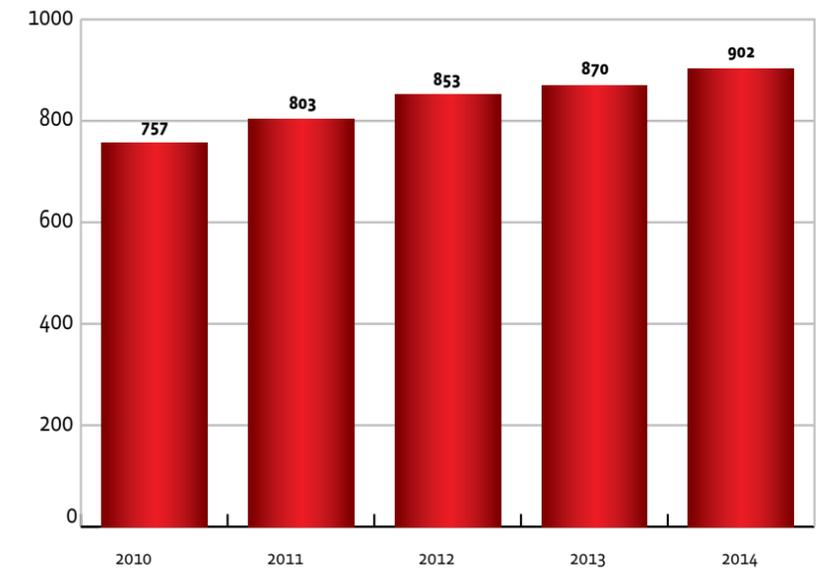
the duties on unexplored or non-exploited licensed hectares for two consecutive years during the first eleven years since obtaining the license; and an Extraordinary Mining Duty on sales of gold, silver and platinum, at a 0.5% rate. Until then, Mexico was one of the few countries that did not apply mining taxes or royalties, despite the

need to share the benefits of this activity with the communities.

Approximately 80% of the revenues generated by these taxes goes to the Fund for Regional Sustainable Development of Mining States and Municipalities. Of this amount, 62.5% goes to the municipalities where the exploitation and extraction of substances and minerals took place, and the remaining 37.5% is allocated to the corresponding state. To apply the resources of the fund during 2015, a total of 25 Regional Development for Mining Zone Committees were formed, each one with representatives of the Federal Government, the respective State Government, municipalities, native or farming communities and mining companies.

The FDL itself states that the resources should be spent on building, renovating and equipping schools; paving and maintaining local streets and roads; as well as installing and maintaining street lighting; landfills; water treatment plants; public sewage, solid waste management and air quality improvement; works to preserve natural areas such as reforestation and rescue or rehabilitation of rivers

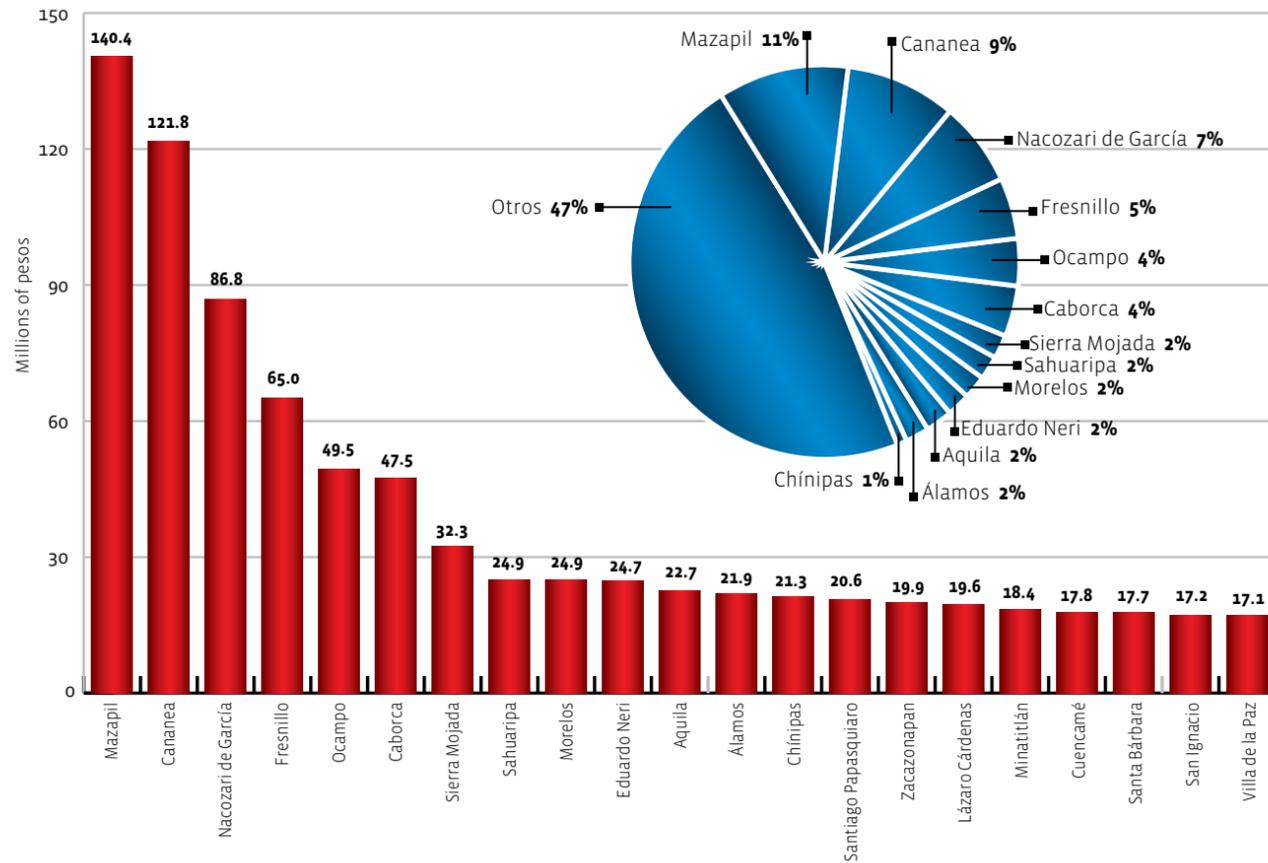
MINING PROJECTS OF COMPANIES WITH FOREIGN PARTICIPATION



Includes projects in different stages of development. Source: General Directorate of Mining Development, Ministry of Economy

DISTRIBUTION OF THE REGIONAL SUSTAINABLE DEVELOPMENT FUND

MAIN MUNICIPALITIES (PARTICIPATION IN PESOS)*



* With figures to March of 2015
Source: CGM, Ministry of Economy

and other water bodies, and works that positively affect urban mobility, including commuter rail systems, metro-cable transport or equivalent. The proceeds from the fiscal year 2014 amounted to approximately 2.6 billion pesos.

Thus, municipalities and mining entities will have greater budgetary resources to be used for the benefit of the communities where they operate, serving the needs of health, education and infrastructure in accordance with the priorities that each of them define, depending on the conditions and requirements of the population. This will boost the positive effect that the mining activity has always had as a factor of development, and will enhance the benefits to the communities, joining the social re-

sponsibility practices of many companies of the sector.

The mining industry is a key activity for national development. Therefore, the Federal Government is committed to supporting its consolidation and growth, creating the best possible conditions for investment in each stage of the mining process. It has made substantial progress in strengthening our competitiveness through substantive reforms, responsible macroeconomic policy and an industrial policy focused on developing geological knowledge of the country. All this contributes to promote the sustainable development of the mining sector, generating economic and social well-being within a framework of respect for the environment. **N**

¹ The Behre Dolbear Group is a consulting company based in the USA, founded in 1911 and with offices in eight countries. It annually publishes the Ranking of Countries for Mining Investment: "Where Not to Invest", based on an annual survey among its specialists, as well as on the results of The Wall Street Journal/Heritage Foundation Index of Economic Freedom and the Global Competitiveness Report of the World Economic Forum, as well as publications of Transparency International.

For the 2015 survey, 25 countries were included and evaluated according to the following seven criteria: economic system; political system; degree of damage that mining activities experiment by social problems; delay in receiving permits due to bureaucratic obstacles and others; level of corruption prevalent in the country; currency stability; and competitiveness of the tax policy. The rating covers a range from 0 to 70, where the latter is the highest possible score

² Approved by Congress on October 31, 2013

MEXICO'S MINING POTENTIAL

- 70% of the country contains mining geological features
- Only 27% of the national territory has been explored



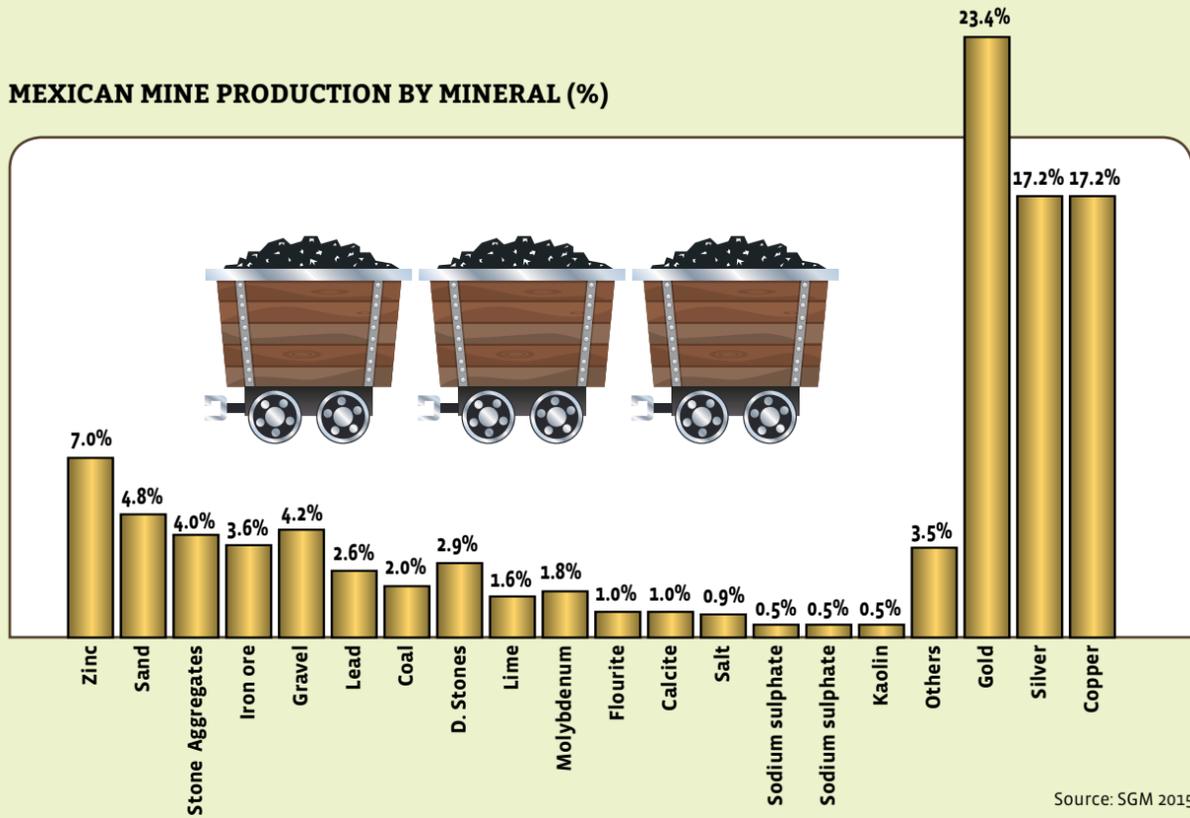
Source: SGM

WORLD RANK OF MEXICAN MINE PRODUCTION

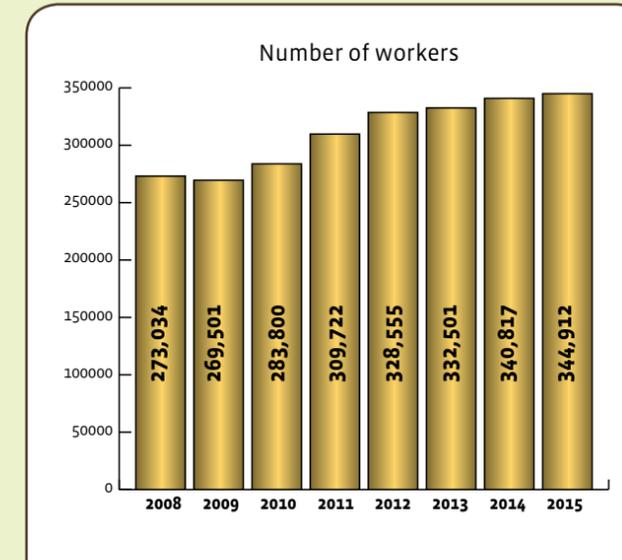


Source: Mineral Commodity 2014

MEXICAN MINE PRODUCTION BY MINERAL (%)

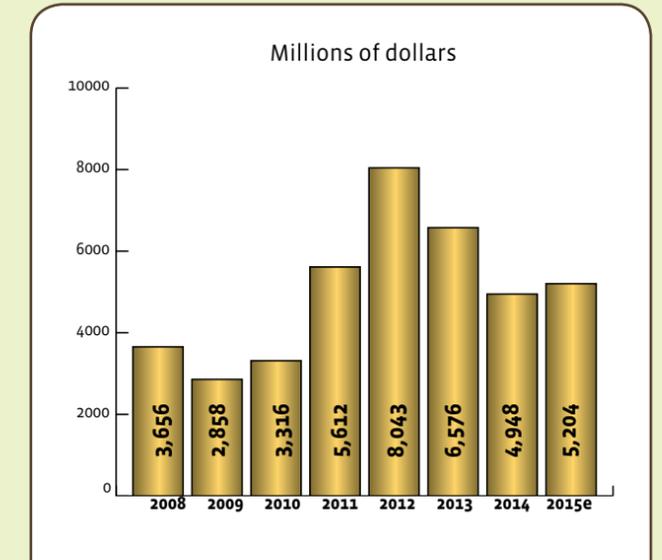


MINING METALLURGICAL EMPLOYMENT

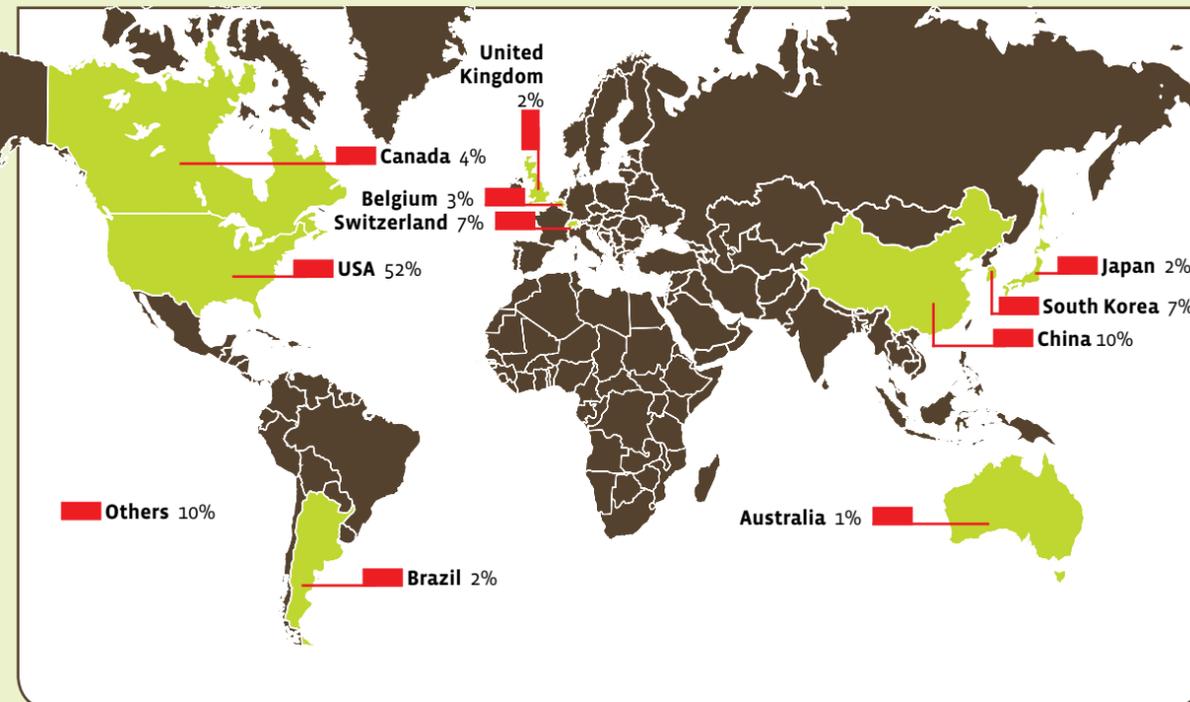


e/ Estimated data
Source: IMSS and CAMIMEX

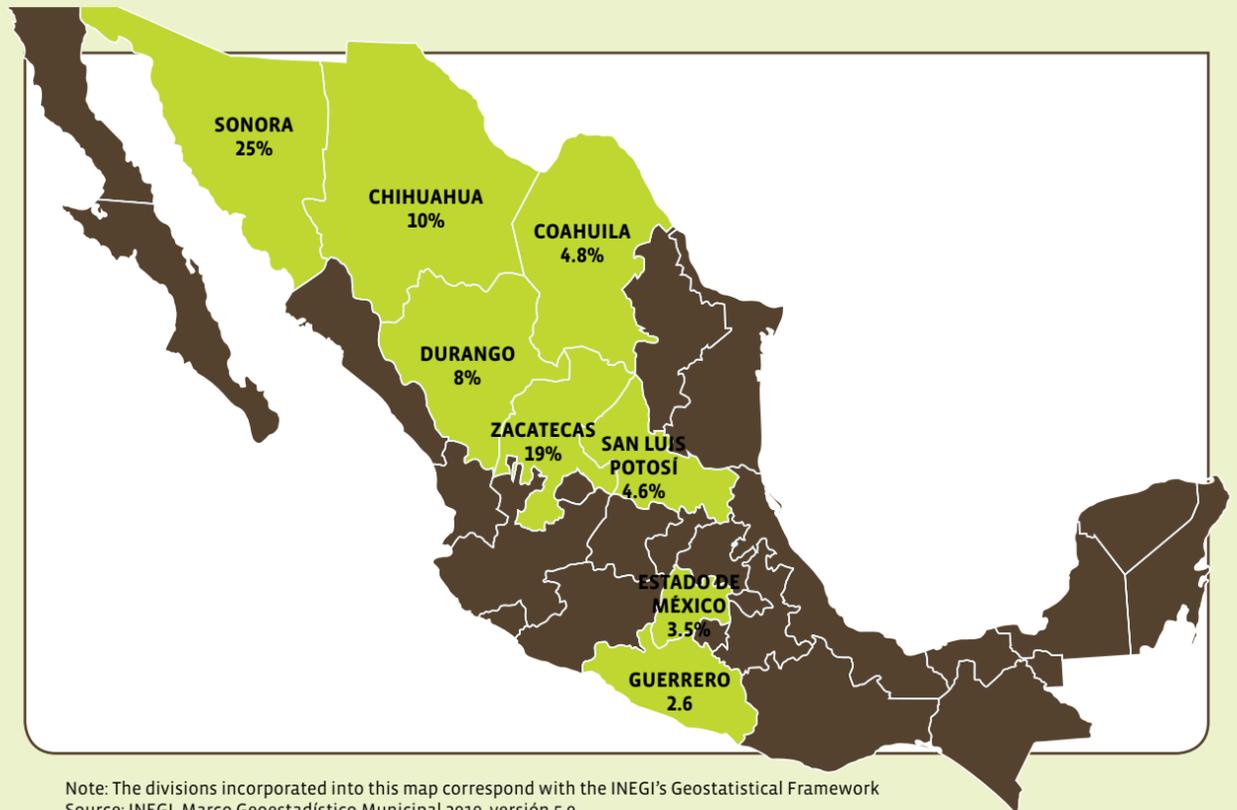
INVESTMENT IN MINING SECTOR



MAIN MARKET OF MEXICAN MINING EXPORTS 2015

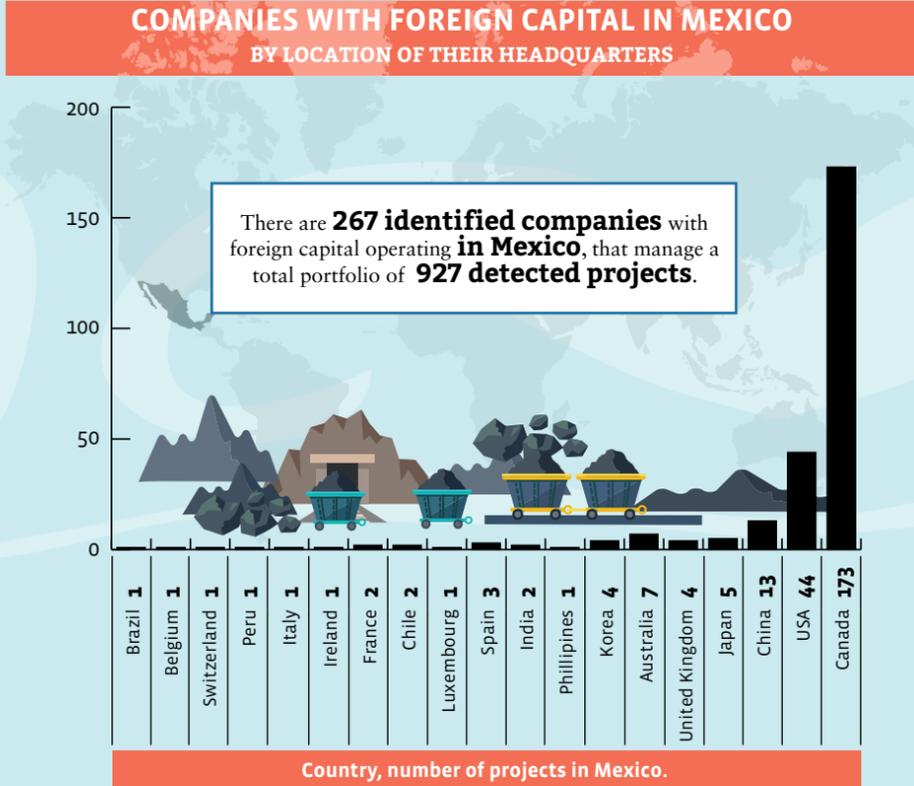


MAIN MINING PRODUCER STATES

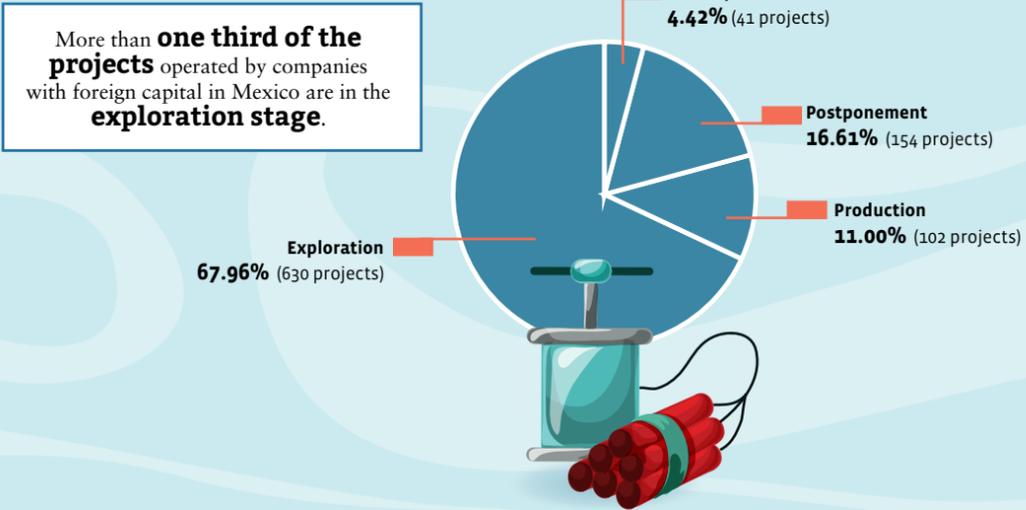


MINING COMPANIES IN MEXICO (2015)

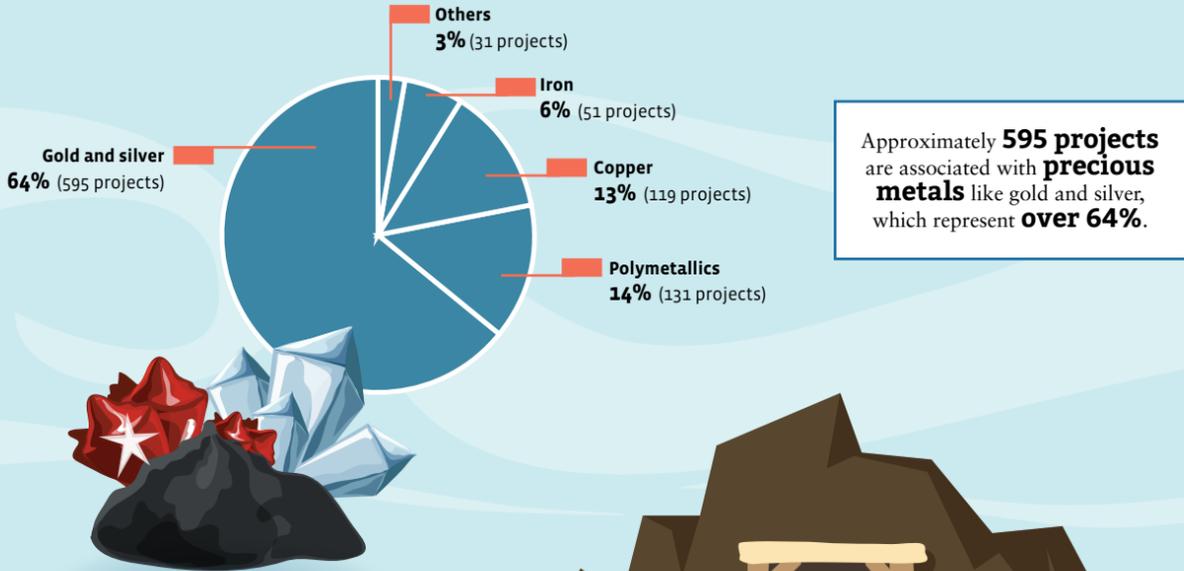
Companies engaged in mining in Mexico come from **nineteen countries in four continents**, and participate with Foreign Direct Investment. These companies have extensive experience in the mining and metallurgical industry and mineral exploration, and they expand their development and meet the global demand for metals.



PROJECTS OF COMPANIES WITH FOREIGN CAPITAL BY STAGE OF PROJECT



PROJECTS OF COMPANIES WITH FOREIGN CAPITAL BY TYPE OF PROJECT (%)



PROJECTS OF COMPANIES WITH FOREIGN CAPITAL BY STATE



Source: Dirección General de Desarrollo Minero (General Directorate of Mining Development), Coordinación General de Minería (General Coordination of Mines), Secretaría de Economía (Ministry of Economy).

Source: Dirección General de Desarrollo Minero (General Directorate of Mining Development), Coordinación General de Minería (General Coordination of Mines), Secretaría de Economía (Ministry of Economy).

THE GEOLOGICAL-MINING POTENTIAL OF MEXICO

This article is a historical record of the development of mineral resources in Mexico. The aim is to present an account that considers the potential of mining today.

BY ENRIQUE GUSTAVO ESPINOSA ARÁMBURU, DEPUTY DIRECTOR OF GEOLOGY, SERVICIO GEOLÓGICO MEXICANO (MEXICAN GEOLOGICAL SURVEY)

Mexico is located in the north-central portion of the American continent, a geopolitical location that bestows upon the country, from Spanish Colonial times, a significant advantage in terms of the trade routes and traffic of all types of merchandise and raw materials. Eventually, for better or worse, it formed a border with a decidedly colonial world power since the 19th century. This gave Mexico a unique opportunity to become a trading partner with the United States, a fully industrialized country.

Many authors have referred to the historical development of mining activities in Mexico, since the intense activity displayed practically the day after the fall of

Tenochtitlán. Researchers like González-Sánchez y Camprubí (2010), for example, report that from pre-Colonial times obsidian, jade, turquoise and opal were used, as were gold and silver, as objects of barter, tools, personal ornaments and offerings. Prescott (1970) reports that Mexicans found a substitute for iron through an alloy of tin and copper that was used to cut, using flint powder, hard rocks such as basalt and porphyry.

Miguel León Portilla (2007) refers to at least two places where pre-Colonial mining works were identified: first, the Cañada de Soyatal (Soyatal Ravine), in Querétaro, where—derived from research

undertaken by the geologists of the Council of Non-Renewable Natural Resources and taken up by the engineer Adolfo Langenscheidt—it was discovered that tunnels, shafts and narrow galleries were used to obtain cinnabar and calcite; second, the Balsas River Basin, where certain cuts indicate that they exploited kaolin and alum.

Meanwhile, Acuña (1985) mentions that in Pachuca both silver and obsidian were exploited since pre-Hispanic times. The *Florentine Codex*, a masterpiece by the famous Fray Bernardino de Sahagún, illustrates how metals were smelted before Colonial times.

METHODOLOGY

To develop the work and to refer the potential of mineral resources in Mexico, the social and economic evolution can be divided into at least five historic mining periods that have marked the past and present of the country:

- Pre-Colonial Mexico
- The Colonial Period (1521-1768)
- The Post Bourbon Colonial Period (1768-1821)
- The 19th century, after Independence (1821-1900)
- The 20th and 21st centuries (1900-2015)

Throughout these stages, although not always with fortune and benefit, the discovery and exploitation of a number of Mexican mining districts was developed. They were the precursors of the current deposits, many of which are still in operation.

Several authors relate historical traces of mining and metallurgical activities among the peoples of Mesoamerica, from the manufacture of sharp devices with materials such as chalcedony, obsidian or

flint—all of them varieties of amorphous silica—to the casting of gold, silver and copper, with vestiges from the archaic period to the establishment of the Aztec culture and other important Mesoamerican societies.

In 1517, after the arrival of the Spanish invaders—called by some “conquerors”—, there are certain acts that link mining with social evolution of the economy, or with tearing up the social fabric, if not also one of the reasons that led to crusades or wars: Cortés asked Montezuma if he had gold. And since he replied: “Yes”, Cortés said: “Send it to me, because my companions and I suffer from an evil heart disease that can be cured with gold.”¹

During the Colonial era, since the discovery of silver veins in 1521 near Taxco, Guerrero, and Tlalpujahua, Michoacán, to the known expansion towards the north and south of the country that resulted in the concentration of villages in the current cities of Pachuca, Guanajuato, San Luis Potosí, Real de Asientos, Zacatecas, Chalchihuites, Concepción del Oro, Durango, Guanaceví, San Dimas, Chihuahua

and Álamos, together with territories of the states of Guerrero and Oaxaca, mining flourished impetuously by 1550. The activity was carried out by fortunate men such as Francisco de Ibarra, who financed the colonization of New Vizcaya (Durango) with the fortunes made by his uncle in Zacatecas (Lloyd Mecham J., 1927) and Juan de Oñate, also inheritor of an uncle who was a miner of the district of Zacatecas (Hammond, G. P., 1927), who exploited not only the deposits but also the available human resources, who were practically treated as slaves.

Therefore, many of these districts and cities—actually true urbanizations in process of development—were the spearhead of the economy of the Colonial period. However, widespread social benefit was practically null, not to mention that the economic usufruct barely remained in the country, and the nascent infrastructure was shaped more conveniently to establish trade routes instead of directly benefiting the miners or the multiple assistants that provided the services required to keep operating mines, which, by the way, gave rise



to blooming farming and livestock as well as industrial activities such as textiles and tanning (León-Rábago D. *et al.*, 2010).

The Habsburg Dynasty, dominant in Europe in the 16th and 17th centuries, lost prominence in Spain and therefore by the mid-18th century the economic system underwent radical changes when the Bourbon Dynasty assumed control over Spain and its colonies. Thus, in 1768, King Carlos III decided to name an inspector directly from the Spanish peninsula to the Viceroyalty of New Spain, an assignment that was entrusted to the not very distinguished—but always active and cruel—José Bernardo de Gálvez y Gallardo, Marquis of Sonora.

The new rules were established through blood and fire rather than by conviction, and they prevailed until 1821, although in 1810, because of the widespread discontent among the Creoles—members of the clergy, society and the royal army—who had lost their privileges when the Bourbon administrative, fiscal and political reforms were established, expressed their rejection to the Spanish peninsular government. They decided to move towards Independence, and therefore initiated a war that

was not consummated until eleven years later, in 1821, in the midst of battles, disorder, persecution and growing uncertainty. Meanwhile, mining operations remained active, albeit no significant findings were reported during this period.

The longed for Independence from Spain generated more confusion than security. The main problem was to achieve political stability supported by economic growth, and the most significant resource was the export of minerals, since agriculture and manufactures were seriously affected by the war.

New Spain, since 1550, with some ups and downs, was already the primary producer of silver in the world, and was the reason why, despite everything, mining had become the most important industry for the economy of the Viceroyalty. González-Reyna (1947) reports that between 1781 and 1820 over 19,000 tons of silver were produced, 62.1% of the global sum.

From 1821, and during the rest of the 19th century, the principal mines were distributed in eleven intendancies, integrated by 37 mining districts. Beyond the intendancies of Sonora (one) and Durango (two), the territories of the Californias,

New Mexico and Texas remained virtually untouched and uninhabited. That is why they were easily prey to the expansionist ambitions between the years 1836 and 1847, when they finally became part of the American Union.

Notwithstanding the foregoing, Mexico began its post-Independence era with a remarkable economic decline, contributing only 30% of the world's production of silver, as a result of political instability. In a remarkable historical essay by Enrique Krauze, published in 1994, he describes “a reality based on the actions of multiple ‘caudillos’ (or warlords) that, as a whole, embodied the country's historical tensions during the 19th century, for better or worse. Some of them visualized a future of material well being and political freedom; others were guardians of the traditional and Catholic past. Liberals and conservatives both undertook their mission with the conviction of a holy war,” and, as Krauze writes: “Although the branch separated from the trunk in 1821, it has always remained secretly loyal to it.”

It was not until 1885 when Mexico accelerated its development as a result of the strenuous efforts of Benito Juárez, as

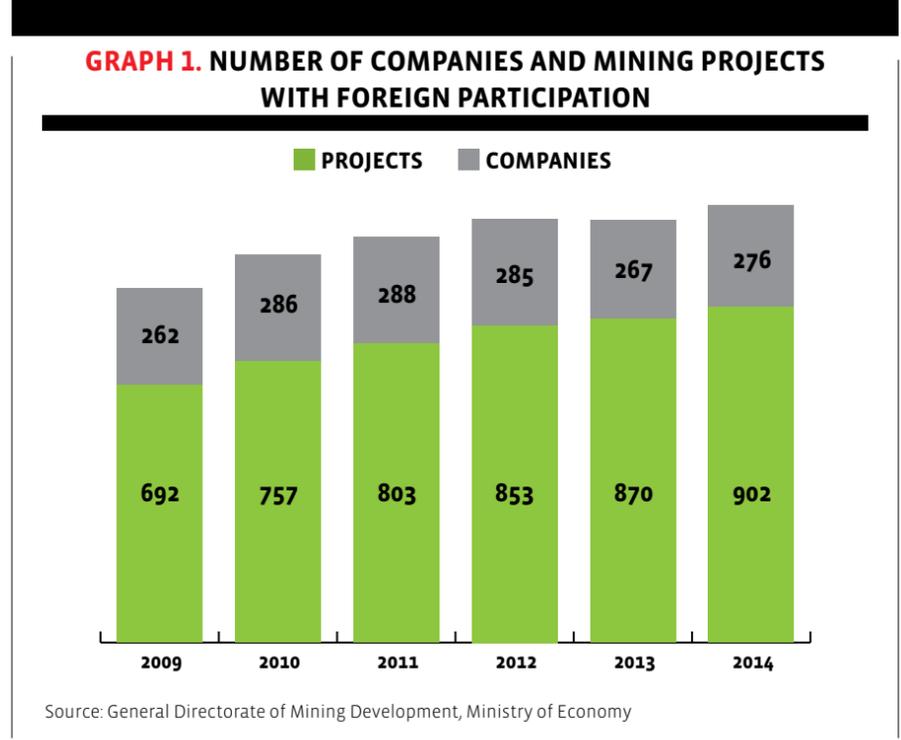
well as the conciliatory efforts of Lucas Alamán—a staunch conservative—and the Second Empire headed by Maximilian I, between 1864 and 1867. During this period, between 38 and 42% of the world production of silver was from Mexico, in contrast to the years of the Reform Wars (1857-1861), when it reached 49% (González-Reyna, 1947), which indicates that the mining activity continued despite the political instability of the country.

Indeed, Krauze (*op. cit.*) says that in 1885 the foreign debt was renegotiated and the construction boom of railroads started (638 kilometers in 1876 to 19,280 kilometers in 1910), while the country began to integrate a very active domestic and foreign market. Agriculture grew 4%, industry 6% and mining almost 8%. Unlike the Bourbon era, growth was broad and diversified. Although the Mexican silver peso circulated in Europe, the USA and even China, Mexico not only prospered from silver, but from other industrial metals.

In 1894 the country recorded its first (and probably only) budget surplus in history. Foreign investment also flowed into the country in incredible amounts. Towards the end of the 19th century the San Rafael Vein in the Tlalpujahua mining district was discovered, thanks to which, through a two-kilometer long tunnel, the El Oro district was developed. The companies, one British, one French and one American, exemplified the arrival of foreign capital destined for mining activities (Flores T., 1911). By 1908 there were 1,030 mining companies with a total investment of 363 million gold pesos. Of these, 840 were American, 40 British and 2 French, with a participation in the total investment of 68.9%, 20.1% and 3.3%, respectively (Urías, 1980).

All this economic and social transfer made clear that the geological knowledge of any country is essential for developing metallogenic theories that explain the origin of the different types of mineral deposits. Also, it is the touchstone that triggers exploration. From the late 19th century, therefore, governments fostered the creation of geological and mining services, in charge of monitoring, managing and above all exploring the territories in order to make and inventory of the available resources.

Mexico was no exception: in 1889 it presented the first Geological Map of



Mexico at the International Fair in Paris; in 1891 it founded the Geological Survey of Mexico (precursor of the prestigious Institute of Geology of the UNAM), which was put in charge of studying the country's mineral resources; in 1904, the Mexican Geological Society was established; and finally, in 1944, the Steering Committee for the Research of Mineral Resources was created.

Therefore, the 20th century began with favorable conditions for the country's development prospects. However, at the same time growing social inequality led to unrest that eventually broke out as a violent and disorganized social movement that lasted eleven years (almost the same time as the Independence movement of a century earlier).

Once again, despite the fact that the Revolution affected the mining industry, operations continued even during the bloodiest years of the war (León-Rábago *et al.*, 2010a), and although companies recorded lower production and sales, these were due rather to the laws of the international market, as copper prices fell in 1907 and silver prices were down between 1914 and 1916. In 1925 capital and investment from French, British, American and also Mexican companies produced a total of

24,541 tons of gold, 2,890 tons of silver and 51,336 tons of copper, mainly in the states of Baja California (El Boleo), Chihuahua, Durango, Guanajuato, Hidalgo, Estado de México, Jalisco, Michoacán, San Luis Potosí, Sinaloa, Sonora and Zacatecas. All over the country, in the districts and provinces, methods of exploration and beneficiation were modernized. Also, profits became evident: during the Porfiriato, mine operators were the highest paid compared to other industries, unlike the almost null distribution of wealth among the workers that operated the mines from Colonial times through most of the 19th century.

In the 20th century, due to the pressing need for raw materials during the two world wars, at a much larger scale than during the Industrial Revolution—that is, from the second half of the 18th century to the first quarter of the 20th century—minerals became vitally important for the countries involved in these major conflagrations. Antimony, molybdenum, copper, magnesium, silver, tin, iron and even mercury, to name the most common, were highly coveted and valued.

Mexico, because of the diversity of its geological structures associated with the deposits, was involved in the global effort to supply the demand for raw materials,



including minerals. No wonder, in 1944 President Manuel Ávila Camacho formalized the creation of the National Research Institute for Mineral Resources, predecessor of the Mexican Geological Survey.

According to Morales Treviño (1999), “from the late 30s, stagnation of investments in mining became apparent, due to the obsolescence of fixed capital elements, the absence of major technological innovations and the cessation of exploration activities. Mining monopolies chose to direct their investments to other countries with more liberal mining legislations. Only the increase in demand of mineral products that accompanied the outbreak of World War II and the Korean War allowed temporary relief for the Mexican mining industry, but did not revert the general trend towards the stagnation of the industry”.

RESULTS

From the second half of the 20th century, a real struggle took place to rediscover the country’s mineral resources. Exploration techniques were modernized in line with the development reached during World War II. With the generalization of the plate tectonics theory, most companies conducted geological surveys in many former mining districts: Taxco, Guanajuato, Pachuca, Parral, Santa Bárbara, San Dimas, Concepción del Oro, Santa María de la Paz, Cerro de San Pedro, El

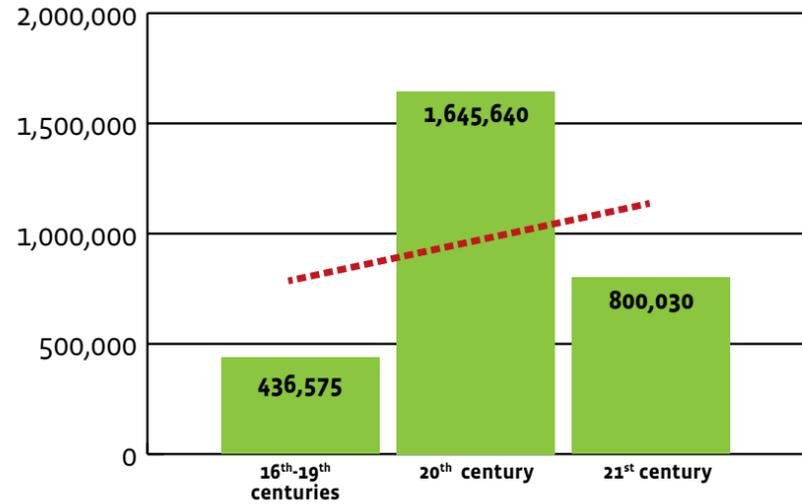
Boleo, San Martín, Cananea, Nacozari, La Herradura, Real de Catorce, Taviche, San José de Gracia, Cuatro Palmas and Sierra La Encantada, to name a few. Also, the exploration of iron ore and coal consolidated, both in perfectly distinct geological provinces.

The metallogenic theories provided concepts that researchers adopted and

developed to relate geological evolution to the spatial distribution of mineral resources. By the end of the 20th century, Mexico was already embedded in scientific and technological modernity in terms of mineral exploration (which, of course, incorporates significant advances in remote sensing and digital programs).

Hence, many old districts were again

GRAPH 2. PRODUCTION OF GOLD IN KILOGRAMS



revised, and fresh resources were found or expanded. For example, Cerro de San Pedro, in San Luis Potosí, was seen in a new light that had nothing to do with the simple exploitation of the veins that the Spaniards had discovered in the 16th century. Such is the case of the regions of Guanaceví, Durango; Nukay, Guerrero; El Oro and Tizapa, Estado de México, as well as the deposits of stratiform copper fluorite, celestite and lead-zinc in Coahuila.

For its part, the exploration of oil and gas has become widespread since 1904 thanks to the discoveries made by geological engineer Ezequiel Ordóñez, who developed the first commercial oil well in Mexico. His estimates were based on geological reasoning, which is somewhat different to the method used for mineral exploration, but not separate from evolution theories and geological-structural history of the Mexican provinces and sedimentary basins.

Mining, however, continues to be a risky activity. Despite technological advancement, the search and exploration of minerals is expensive. It is not unusual for a mining company to spend five to ten million dollars in a property before having enough information to determine whether it is feasible. Statistics presented by R. M. Wanless in 1983 show that only one out of every one thousand exploration projects will become a mine. There are also factors related to global modernity that affect



these activities: economic ups and downs that give value and price to all raw materials, including minerals.

Production, however, has markedly increased compared to previous eras. That is why 902 projects were still in effect or in exploration in 2014. At the same time, according to figures released by the Department of Mining Development of the Ministry of Economy (see Figure 1), 276 companies were exploring in Mexico. This means that,

in one way or the other, the country has continued to be attractive for mining exploration, even though the prices of gold, silver and copper began to slide in 2013-2014.

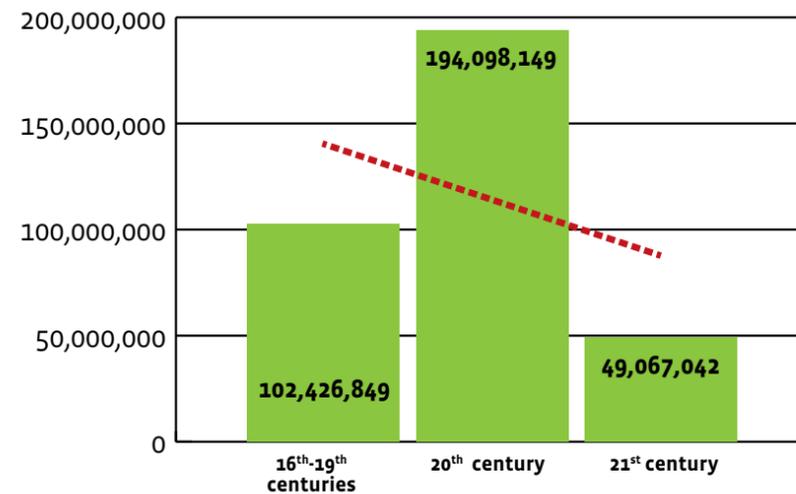
In some newspapers, statements and other media outlets we have read and heard that in only one decade more silver and gold was produced in Mexico than during the 300 years of the Spanish Colony, which is strictly true. The reason is that in those times only native ores could be exploited, not compounds such as sulfides, oxides or tellurides. This limited exploration, because when a mine reached a sulfide zone after exhausting supergenic enrichment, it was abandoned due to the lack of technology to benefit the mineral. Graphs 2 and 3 confirm the remarkable contrasts of gold and silver production from one epoch to another, as well as the trends in both cases.

CONCLUSIONS

Clearly, Mexico has mined large volumes of silver, gold and a great variety of basic non-metallic minerals, including coal, manganese and iron. This was accomplished initially based on empirical knowledge and, subsequently, as a result of a system of geological ideas and concepts.

Mineral resources have been explored and exploited for almost five centuries; some regions are still in continuous or intermittent operation, such as Taxco, Guanajuato, Zacatecas, Cerro de San Pedro,

GRAPH 3. PRODUCTION OF SILVER IN KILOGRAMS



Zacualpan and Parral, and others have been the result of the interpretation of geological structures and the proposal of metallogenic models that offer new expectations.

Since 1995, the Council of Mineral Resources (today's Mexican Geological Survey) made available a series of geological maps that contain the relationship of mineral deposits with the most notable structures and the description of stratigraphic sequences. These are letters to scales of 1:250,000 and 1:50,000, to display features that also researchers and students often use.

Geological mapping is a public asset recognized as a decisive factor in encouraging capital and investment, since it is a tool for identifying potentially favorable areas. It incorporates geochemical results in stream sediments and is assisted by aerial magnetometer maps and magnetic data that are useful for mineral and oil exploration.

The geological map of Mexico synthesizes geomorphological features where geological and metallogenic provinces are profiled, such as the western Sierra Madre, the eastern Sierra Madre, the Sabinas Basin, the Coahuila Platform, the Central Mesa, the Neovolcanic axis, the magmatic complex of the South Pacific, the Sierra de Chiapas and the coastal plain of the Gulf of Mexico.

Since 2005, the Mexican Geological Survey has detected 700 prospective areas derived from cartographic surveys, of which 15% have become mining allotments; that is, areas with geological and economic value that are offered at public tenders for development as projects. Systematic mapping allows us to visualize that there are still extensive regions with potential, although they must be further explored with metallogenic theories, experience and, above all, verification in the field.

Based on the history of exploration, geological variety, experience and cartographic works, there is still a vast untapped mining potential in Mexico. There are eight mining allotments in geological environments: two in the western Sierra Madre, one in the Sabinas basin, three in the Chihuahua basin, one in the province of orogenic gold in northwestern Sonora, and one in the phosphorite province of La Paz, Baja California Sur. New projects will be presented in the future, established in different provinces, confirming that explorations continue to bear fruit in our vast country. **N**

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Acknowledgements

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¹ Francisco López de Gómara, "Historia General de Indias" ["General History of the Indies"]; 2 vols. Barcelona, 1954, en Mineros y Comerciantes en el México Borbónico [Miners and Merchants in Bourbon Mexico] (1763-1810), D. A. Brading, Fondo de Cultura Económica, 1975

MEXICO'S MINING HIGHLIGHTS (OCTOBER 2015)

From **1521 to 1832**, Mexico produced **191 tons of gold and 33,000 tons of silver**.

In ten years, from **2005 to 2014**, **732.7 tons of gold and 41,922.9 tons of silver** have been mined.

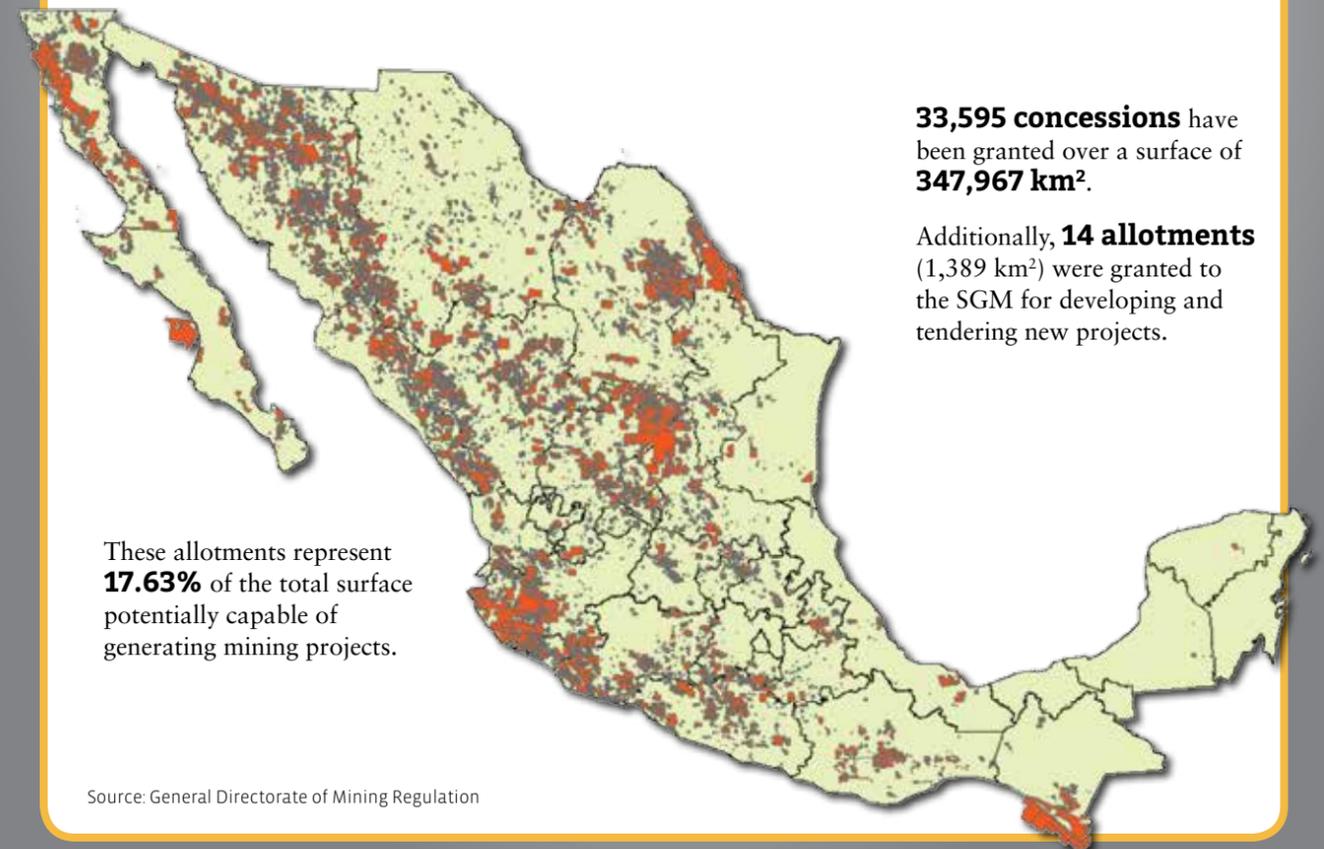
In **2014** Mexico produced **117.8 tons of gold and 5,765.7 tons of silver**.

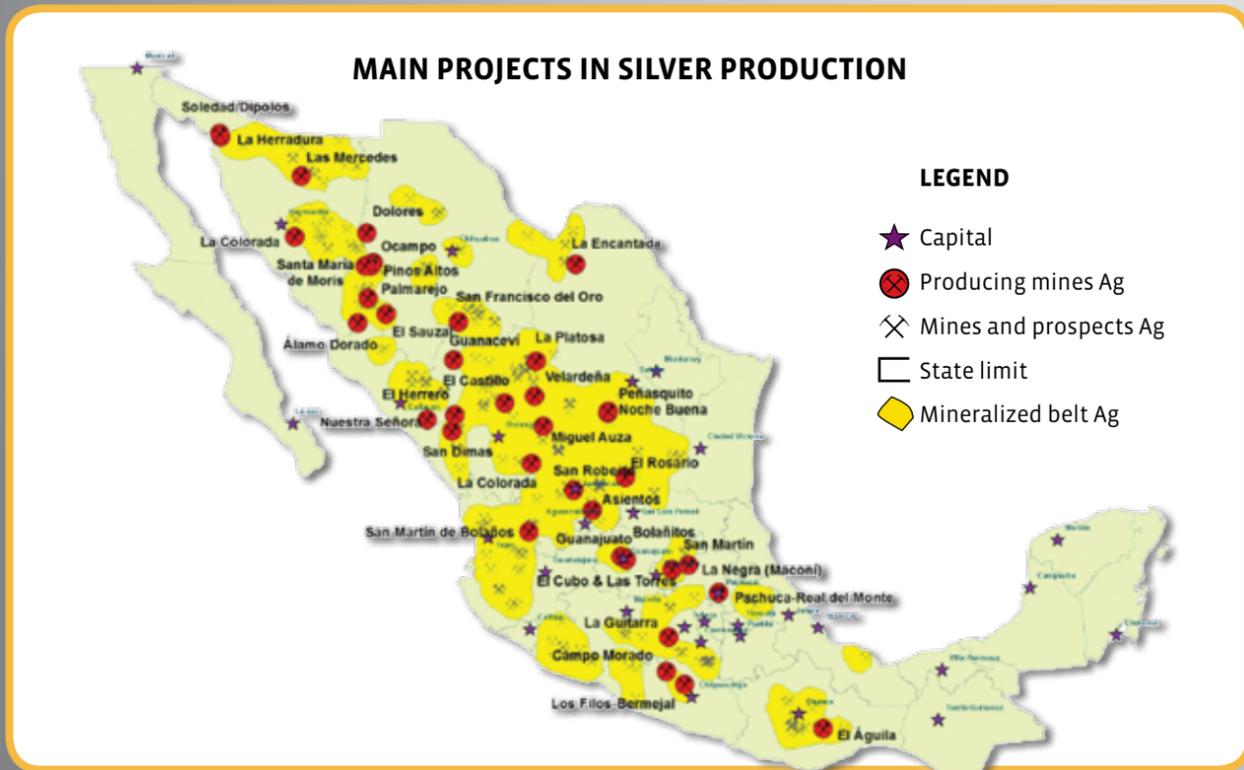
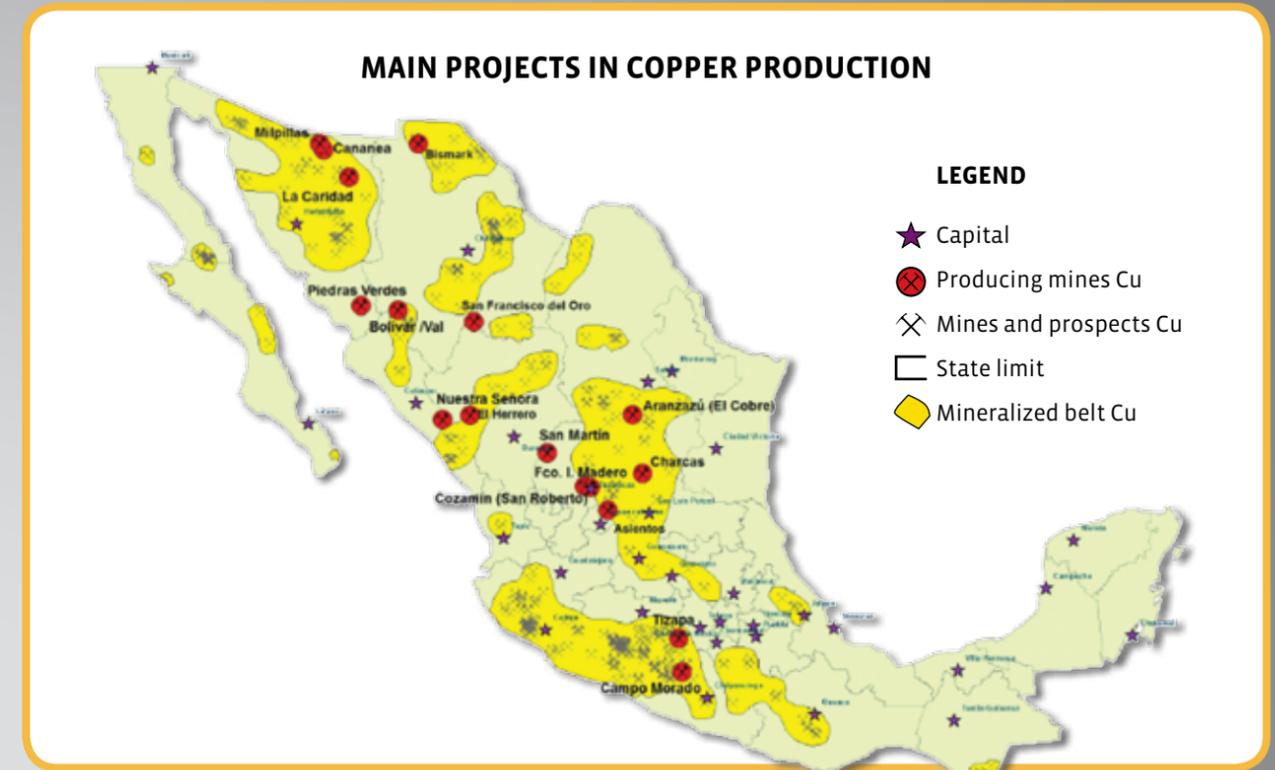
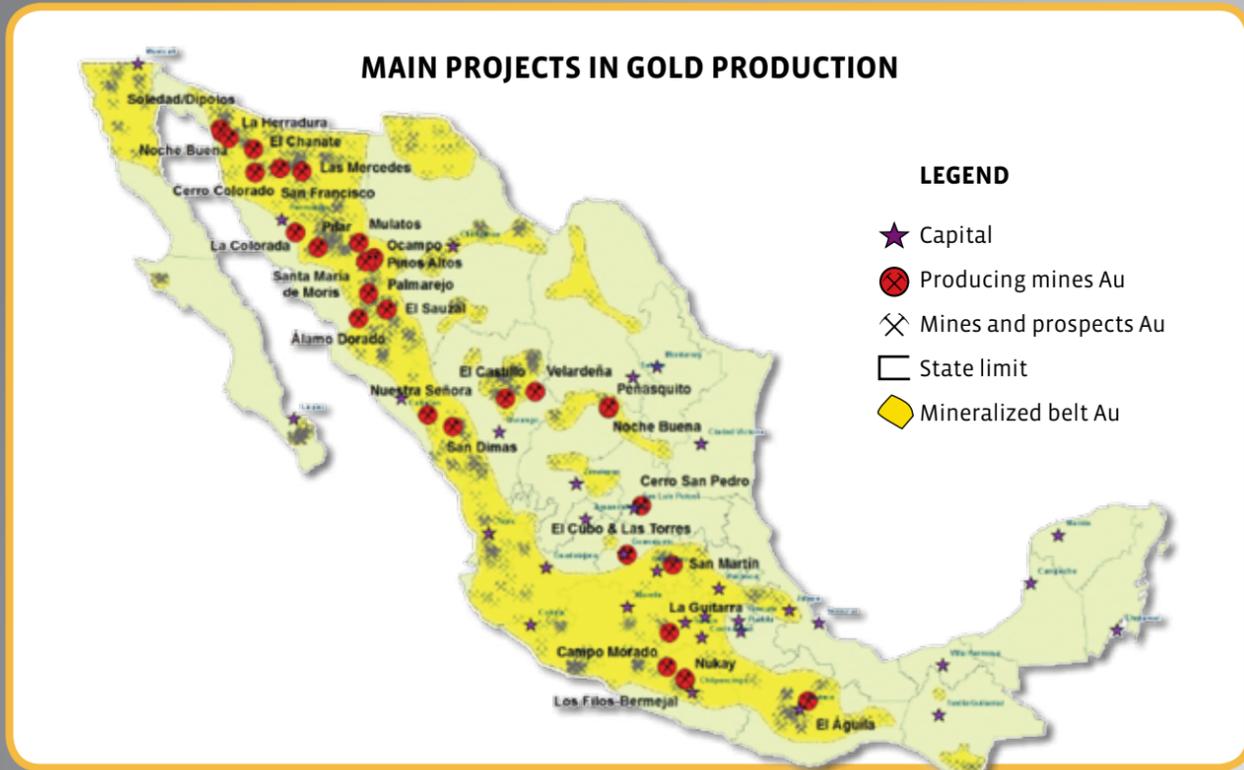


Are there potential and resources in Mexico?

The Federal Government has granted mining concessions for a total surface of **347,967 km²** (17.63% of the country's territory).

MEXICO IS RANKED AS AN IMPORTANT WORLDWIDE PRODUCER OF MINERALS





MINING IN MEXICO A DESTINATION FOR CANADIAN INVESTMENTS

The relentless extractive industry has placed Mexico in a leading position as a producer of various minerals worldwide: the country occupies the first place in silver production, and is the second largest producer of fluorite and bismuth. Our leadership has led us to become the fifth largest producer of lead, ninth in gold, and tenth in copper.

BY LUIS BRASDEFER, RODRIGO CONTRERAS AND JOEL ENRÍQUEZ, PROMÉXICO'S COUNSELLORS IN VANCOUVER, TORONTO, AND MONTREAL, RESPECTIVELY

Is the occasion appropriate for a silver bracelet? Leaning over the counter in a jewelry store on one of the main streets of Vancouver and undecided about which gift to choose, the executive takes his smartphone and calls his wife to ask for feedback. He can't imagine that the bracelet and the micro-conductors is his phone have something in common: their silver components are most likely to be the result of the mining industry in Mexico, and have therefore contributed to the country's domestic prod-

uct, had an impact on its trade balance and have led to the creation of jobs.

But the position Mexico has in the mining industry today is not accidental. Mining is an industry with a long tradition in Mexico, with more than 500 years of history. Its background dates to pre-Columbian times, when the civilizations established in the region used precious metals for creating various items of a priestly nature. Later, with the arrival of the Spaniards, the extraction of these

metals became a prominent activity. Back then, "exports" from the Colony to the Old Country began, and quickly reached a high proportion of the total exports from New Spain. The tradition of the mining trade continued and even grew during the Porfiriato era, giving rise to towns and communities that have flourished under this industry bearing witness to the mining vocation of entire regions.

Today, this tradition of centuries has established itself as an industry that encompasses various minerals, although it focuses primarily on silver (26%), gold (22%), copper (18%) and zinc (7%). This mineral extraction covers several states across the country, including Sonora (with 25% of

The mining sector generates close to 345,000 direct jobs and 1.5 million indirect jobs.

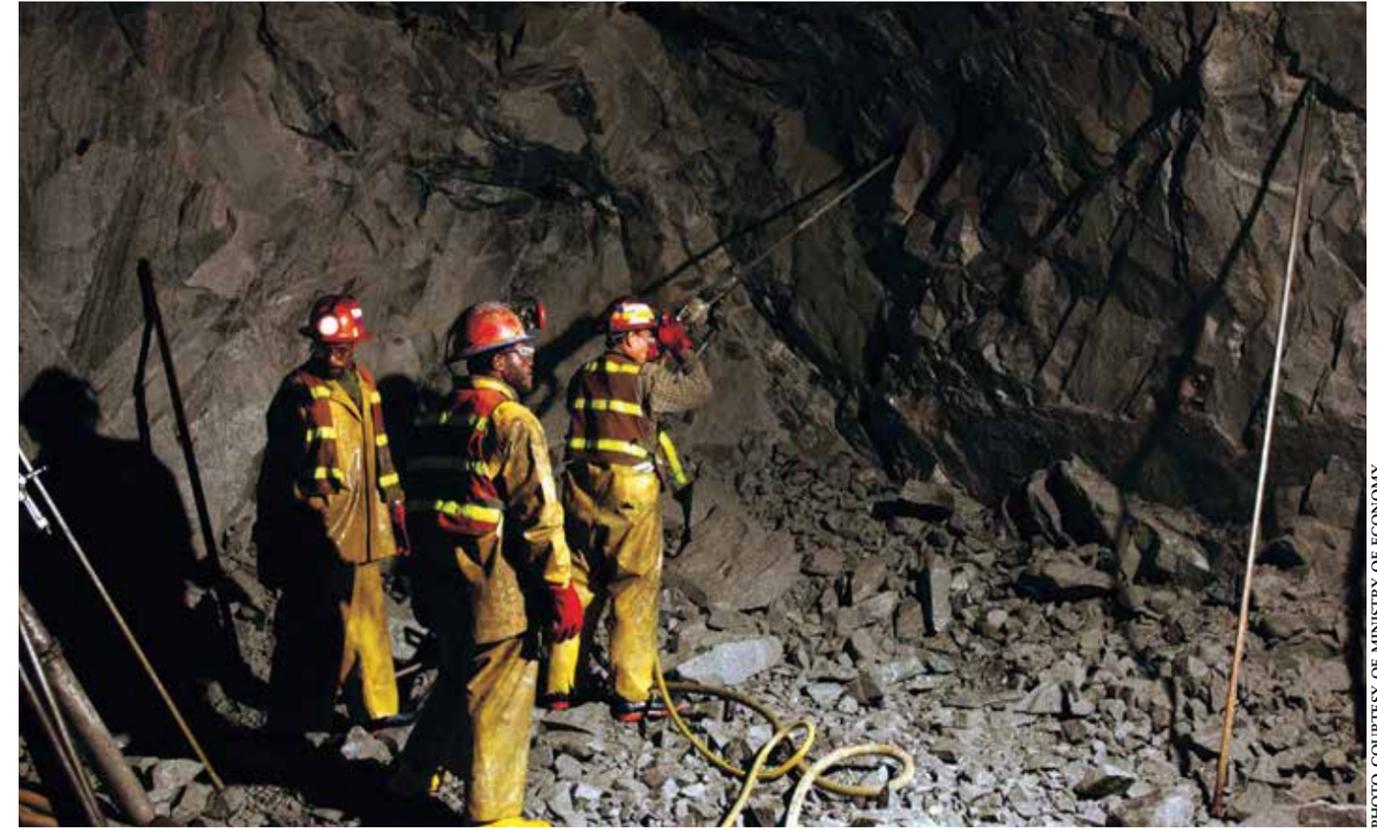


PHOTO COURTESY OF MINISTRY OF ECONOMY

In economic terms, the benefits of investing in the mining sector is particularly important because it contributes more than 5% of GDP and is the fourth source of income, only after the automotive, electronic and oil industries.

the national production), Zacatecas (19%), Chihuahua (10%), Durango (8%), Coahuila (4.8%), San Luis Potosí (4.6%), Estado de México (3.5%) and Guerrero (2.6%).

The relentless extractive industry has placed Mexico in a leading position as a producer of various minerals worldwide: the country occupies the first place in silver production, and is the second largest producer of fluorite and bismuth. Our leadership has led us to become the fifth largest producer of lead, ninth in gold, and tenth in copper.

In economic terms, the benefits of investing in the mining sector is particularly important because it contributes more than 5% of GDP and is the fourth source of income, only after the automotive, electronic and oil industries. The mining sector generates close to 345,000 direct jobs and 1.5 million indirect jobs.

Mexico and Canada have a long tradition of partnership in the mining sector. While 60% of the production in our country is in charge of national companies like Peñoles and Grupo México, 285 companies with foreign capital produce the remaining 40%, with an investment of over 25 billion dollars in the last five years, and over 850 mining projects in operation. Of these, 210 are funded by Canadian capital, almost 75%.

Undoubtedly, foreign direct investment is attracted to the mining sector by the wealth and diversity of the underground deposits in our country, which have only been exploited in 30%, according to estimates. There is 70% of fertile territory available for exploration and exploitation. However, our mineral wealth is not the only factor that attracts foreign capital, which values other advantages that are

not exclusive to this sector, but common to other fields of investment, such as the climate of investment protection after enacting almost thirty international agreements with this objective; the facilities found by foreign companies for creating and operating businesses here; and a young and skilled workforce (only in the area of engineering over 100,000 graduated engineers are available).

In view of the importance of the mining industry to our country, its operation is properly regulated by an appropriate legal framework based on the pillar of our Constitution, and includes a specific set of laws such as the Mining Law and its regulations, the Mining Sector Public Service Manual and the Foreign Investment Law and its regulations. For the proper promotion, supervision and regulation of the activity, powers are given to the Ministry of Economy, which exercises them through the General Mining Coordination, the General Directorate of Mines, the Public Registry of Mining and the Mexican Geological Service, which act in coordination with the Mining Promotion Trust. **N**

McEWEN MINING THE MEXICAN EXPERIENCE

Locally, the company claims to have developed several ways to reduce both traffic and dust generation, while becoming involved with community schools and in building local water wells. McEwen says that they try to improve the standard of living in the areas where they operate. "As a society we need to find a balance between protecting the natural ecosystem while maintaining a sustainable and growing economic ecosystem. Unfortunately, the perception of the majority of citizens is that mining is a harmful activity. They do not appreciate the positive contribution of mining at a local level of improving living standards, employment opportunities, education, health and welfare. In many situations, the mining companies are providing services and facilities that the state and federal governments have yet to provide. If Mexico wants to be a leading country it must ensure that it remains an attractive and safe destination for foreign capital investment."

INTERVIEW WITH ROB MCEWEN, EXECUTIVE AND CHIEF OWNER OF MCEWEN MINING, INC., BY RAQUEL RIVAS

McEwen Mining, Inc. is the result of the merger of US Gold Corp. and Minera Andes, Inc. Among the company's major assets are the San José gold and silver mine in Santa Cruz, Argentina; the El Gallo gold mine and the El Gallo Silver project in the state of Sinaloa, Mexico; the Gold Bar project in the US state of Nevada; and the copper project Los Azules, in San Juan, Argentina.

"We have been operating in Mexico since 2008. Our initial focus was exploration in an area that had been previously mined. Our objective was to expand the gold resource that existed on the property. Our exploration has been successful finding additional resources, which supported our decision to restart mining. Our first year of commercial production at our El Gallo gold was 2013. Our exploration also discovered a silver deposit that we have advanced to the point that it is ready to be built. While we have received the necessary government permits to start construction of a new mine, the decision to start construction has been deferred until the price of silver increases to above \$18/oz.," explains Rob McEwen.

"The company's investment in the communities around the

mine which largely subsisted on agriculture, have generated diversity in the local economy, job opportunities for the community and a brighter future. This I would say has been our biggest contribution to Mexico, giving members of the commu-

nities the opportunity for a bigger future," says the Canadian executive.

FOR A BETTER MEXICO

The company is comfortable in this country due to its mining history, experienced work

force and the environmental regulations established by the Mexican government. "I believe that regulations set by public institutions are progressive and reflect many of the best environmental practices demanded by rest of the indus-

"We have been operating in Mexico since 2008. We started our gold mine in 2013. We discovered a new silver deposit in 2009 which is now permitted to build but we need a higher silver price and stronger capital markets before it can be built," explains Rob McEwen.



McEwen says that in addition to working with more than 150 Mexican suppliers, they are looking at ways create a new sources of employment once the mine closes.

trialized world. In essence, the Mexican government has required foreign mining companies to meet and continuously demonstrate commitment to mining practices that protect the environment and highlight ecological responsibility. For a publically listed company, such as ours, protecting the environment and our employees is not an option, it's mandatory."

THE MEXICAN PROJECT

Mexico can boast of possessing a long historical tradition of mining, and an experienced workforce. The executive believes it would be very beneficial for the industry to empower its employees in order for them to execute important actions individually, without the need for approval from upper echelons.

Currently, McEwen Mining, Inc., based in Toronto, Canada, owns the El Gallo

gold mine and the El Gallo silver project located in northwestern Mexico, along the foothills of the Sierra Madre.

The El Gallo gold mine achieved its first gold pour in September 2012. The first full year of commercial production was in 2013. And gold production has increased every year. In 2015, the mine produced 63,000 ozs. of gold.

The other project, El Gallo silver, received its final environmental permit required for the construction and operation the mine from the Semarnat in January 2014. The mine, when built, is forecast to produce an annual average of 5.2 million ounces of silver and 6,100 ounces of gold. However, the decision to build the mine has been deferred until the price of silver rises above US\$18/oz. and the capital markets of mining projects improve.

EXTENDING THE LIFE OF A MINE

A successful exploration program is one of key factors to extending the life of any mine. "This year our exploration budget is US\$5 million. Other key factors are improving the recovery rates for the gold/silver mined, along with lower operating costs. Employing new technologies will allow us to more closely monitor and measure our performance in all aspects of our operation. In the current environment of low gold and silver prices, increased wage demands, increased government taxes and increased security costs, there is a big focus on driving down operating costs. We currently work with more than 150 Mexican suppliers and have 478 employees and the mine contractors working at the mine," says Rob McEwen.

Ultimately, all mines come to an end. Historically, in the

absence of any other economic activity in the area, the closure of a mine often resulted in ghost towns, because the inhabitants are forced to migrate for lack of job opportunities.

So the big challenge in all mining communities is to find a legal alternative source of sustainable economic activity. "Around our mine the land is considered marginal for traditional agricultural practices."

In the case of Mexico, McEwen has a totally different project in mind for reclaiming the mine site once the mining stops.

"What I'd like is to transform our mine, when it closes, into a tourist destination, with the help of Mexican architects," says Rob McEwen, "I envision it as a place of sports, recreation and relaxation for the local communities and for people living in cities to get away on weekends. In this way, we would help create a new industry that could provide ongoing employment and new skills for local residents." **N**

PRIMERO MINING CORPORATION A GOLDEN FUTURE

Primero Mining Corporation announced a record annual production of 259,474 gold equivalent ounces in 2015, 15% higher than in 2014 and within the company's 2015 production guidance range. The company expects to take advantage of the Energy Reform.

INTERVIEW WITH ERNEST MAST, PRESIDENT AND CHIEF EXECUTIVE OFFICER, PRIMERO MINING CORP.

Primero is a Canadian based mid-tier gold producer with two producing mines and a pipeline of development projects. It was established in August of 2010 following the acquisition of the San Dimas mine from Goldcorp. In 2013, it acquired the Cerro del Gallo development project in Guanajuato, Mexico, and in 2014 acquired the Black Fox Gold Mine in Ontario, Canada.

Primero's development in Mexico has been focused mainly in four areas:

1. Increasing production at the San Dimas mine through underground development and capacity increases in the plant. Primero has expanded the San Dimas capacity from approximately 1,500 tons per day when it was acquired in 2010 to 3,000 tons per day expected by September 2016. In order to achieve this goal, Primero has invested over 200 million dollars in capital expenditures and exploration at this mine.
2. Through resource development and exploration at its San Dimas properties, the Ventanas property located 30 kilometers to the south of Tayoltita, and the Cerro del Gallo development project in the state of Guanajuato.
3. Through increases in hydro-electrical power generating capacity at the Las Truchas facility located approximately 42 kilometers to the north of Tayoltita. In addition to providing most

of the mine's electricity, Las Truchas also provides electricity to twelve communities and two saw mills that are located between Las Truchas and Tayoltita.

4. Through the development of Tayoltita roads, a hospital, training facilities, parks, recreation facilities and development of local service providers.

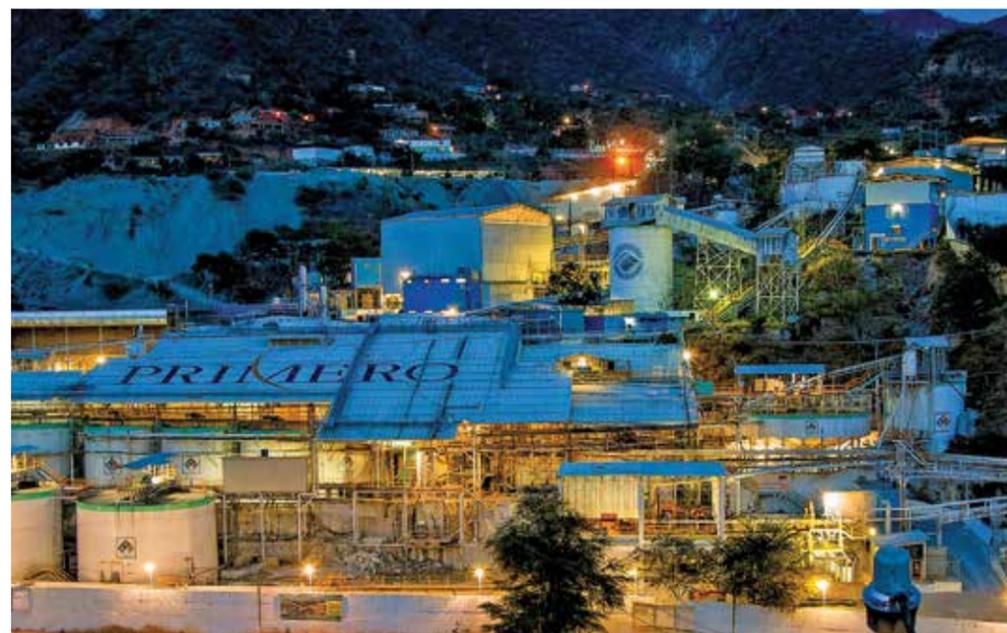
Since 2010, Primero has invested more than 200 million

dollars in capital projects at the San Dimas mine to significantly increase production. This has resulted in improving the corporation's assets underground, implementing an expansion of their plant, upgrading a state-of-the-art tailings facility, improving the conditions and safety factor of their tailings transport pipelines, increasing their hydro-electric power generating facility located 42 kilometers to the north at Las Truchas, improving the safety and security infra-

structure at all of their facilities and improving the capacity and quality of Primero's camp facility for its employees and contractors at Tayoltita.

"Primero has also initiated advanced exploration at the Ventanas property located approximately 30 kilometers south of the San Dimas mine and has so far committed approximately six million dollars to this property," said Ernest Mast, President and Chief Executive Officer at Primero Mining Corp.

"Primero has also initiated advanced exploration at the Ventanas property located approximately 30 km south of the San Dimas mine and has so far committed approximately six million at this property," says Ernest Mast, President and Chief Executive Officer at Primero Mining Corp.



CLEAN INDUSTRY AND PROJECTS

In 2013, Primero acquired the Cerro del Gallo property in Guanajuato and since then has invested 21 million dollars in developing the project for a future mine. The Clean Industry accreditation ("Industria Limpia") has made a marked difference in the industry's environmental performance. It's a voluntary initiative and allows companies to work closely with environmental regulators ensuring regulatory compliance, and also gives the industry a chance to share some of the best practices by different companies. The Company's performance is acknowledged with this recognition.

The environmental approval process, which includes an Environmental Assessment and Change in Land Use permits, follows best practices, ensuring that the closure plan is in effect at the time the mine begins construction.

"One of the areas in Mining that we are seeing more careers in is Corporate Social Responsibility (CSR). There are more professionals dedicated to Social Responsibility in the mining industry than there have been in the past. At Primero, we consider all professions to be of relevance. However, developing qualified mining technical talent takes years and leadership development is essential. For example, mining engineers, metallurgists, geologists, and rock mechanics engineers, just to mention a few, require a long-term development curve. This is why the company is dedicated to investing in the next generation of its workforce with such initiatives as the Conalep technical college in Tayoltita," explains Mast.

Our first priorities are the projects currently in the pipeline which, at San Dimas, include the 3,000 ton per day



Primero's relationship with the College of Professional Technical Education (Conalep), a trade school in Tayoltita, has been one of the most successful achievements over the last few years.

plant expansion which will be completed in September of 2016, the expansion of the tailings pumping system which is expected to be completed at the end of the current quarter, and the tailings storage area upgrade which will start in June 2016 and be completed in 2017.

We plan to start work on the Las Truchas hydro-electricity reservoir expansion to provide 100% of our energy all year long upon obtaining funding.

Other projects include starting construction at their Cerro del Gallo property in Guanajuato, however this is dependent on improvements in the commodity market.

According to Mast, "there is potential to build a new mine for our Ventanas project. This is dependent on results from our exploration program."

THE EDUCATIONAL FORCE

Primero has recently acquired new properties adjacent to, and outside of, the San Dimas concession. The company has plans on mining these areas

within the next three years. "This is a very exciting opportunity because the current mining area is subject to a pre-set sales agreement and by mining outside of the concession we would increase revenues, profits and therefore taxes," said Mast.

Many of these properties were obtained from the Regulator of Mining Activities in the Nation that is a department of the Ministry of Economy. The nation has a progressive manner in which it ensures that concessions are awarded. Primero's relationship with the College of Professional Technical Education (Conalep), a trade school in Tayoltita, has been one of the most successful achievements over the last few years.

Since 2004, the school has been established together with the San Dimas mine where students participate in classroom activities as well as hands-on practical experience in Primero's operations.

"In 2013 our work with Conalep won us first place distinction for practices in educa-

tion and employment from the Secretariats of Education and Labor. We continue to be committed to Conalep and the programs in Tayoltita," detailed Mast.

Primero is seeking to continue developing the Las Truchas hydro-electrical power generating facility in order to become completely self-sufficient in electrical power production through the installation of a second water reservoir of fifteen million m³ capacity. This expansion will allow the electrical turbines to operate at full capacity during the entire year. Additionally, Primero eventually plans to build a new power station which will capture the hydraulic potential of the area by exploiting the next large drop in elevation in order to generate a further 12 MW of electricity which will allow Primero (and a potential partner) to sell this power to third parties located in the area. Primero believes that Mexico's Energy Reform has facilitated the ability for it to consider selling, or obtaining investment in, its hydro-electrical facility.

The hydro-electric phase 2B reservoir project could be in operation within two years and will see results immediately. A further potential expansion of the hydro-electric facility to 26 MW will likely take approximately five years to develop and it too will see immediate results.

Primero's focus will remain in mining, particularly in the precious metals space, namely gold and silver. However, the Truchas hydro facility offers Primero a stable and reliable source of low cost electrical power that from a strategic point of view ensures the long term low cost viability of the San Dimas mine. **N**

www.primero mining.com

ENDEAVOUR SILVER NEW CONCEPTS FOR OLD MINES IN THE MINING BUSINESS

The company brought new concepts to explore and exploit an old mine that was ready to close. Thanks to its initial success, it acquired two more mines in Mexico.

INTERVIEW WITH BRADFORD COOKE, CEO OF ENDEAVOUR SILVER CORP., BY LUIS FERNANDO TECA

In 2004 Bradford Cooke, CEO of Endeavour Silver, and Godfrey Walton, COO, traveled to Mexico to acquire and explore a mine that was about to close, “but it had not been explored or exploited using modern concepts.” So they acquired the old mine, invested to test the new concepts, successfully discovered new orebodies, and twelve years later they continue to extract silver.

The mine, called Guanaceví, is the first and richest mine of Endeavour, and it is located 260 kilometers northwest of the city of Durango.

Access to the mine is from the state highway and the infrastructure includes an electricity network, local labor, supplies and services in the town of Guanaceví, as well as the mine encampment.

The Guanaceví property covers about 4,100 hectares in the fifth largest historical silver district of Mexico. Low sulphidation epithermal veins characterize the district, usually thousands of meters long, up to 700 meters deep and with a range of one to ten meters thick.

Guanaceví is Endeavour's highest-grade silver mine, but

also the deepest. “Since the acquisition we’ve discovered seven mineralized orebodies of high grade silver and gold along six kilometers of the Santa Cruz vein. We’ve opened new mines and concluded the modernization programs and plant expansion,” says Cooke.

Currently, three underground mines feed the central plant with 1,200 tons a day to produce doré bullion with a total workforce of around 540 employs and 100 contractors.

In 2015, the Guanaceví mine produced 3.4 million ounces of silver and 7,390 ounces of gold, for a total of four million tons of silver equivalent. The silver and gold production exceeded their target, because they excavated

higher-grade silver and gold than planned.

INVESTMENT IN 2016

The mining company plans to invest 13.8 million dollars in its Mexican projects. The company notes that this figure could rise up to 25.3 million dollars if and when they obtain feasible financing; the company has three mines in Mexico: Guanaceví in Durango, Bolañitos—Endeavour Silver's second mine and the most profitable—acquired in 2007 and located ten kilometers northwest of Guanajuato; and El Cubo, also in Guanajuato, the third and potentially largest mine, located six kilometers southeast of the city of Guanajuato.

“Our mines Guanaceví and Bolañitos remain profitable at

current metal prices; however, El Cubo continues to yield losses despite our efforts to expand operations and lower operating costs plus other costs sustained in the past three years,” says Cooke in the 2015 Endeavour annual report.

In 2016 the company, one of the leaders in silver extraction in Mexico, plans to invest 11.3 million dollars in capital projects for Guanaceví, mainly for mining development; but it also has a contingent budget to invest 4.5 million in additional development, provided they can obtain financing.

In terms of exploration, Endeavour estimates spending 2.5 million dollars in exploration drilling at Guanaceví, and in the cost of property ownership in Mexico. The company also has a contingent budget for investing seven million dollars in additional mining development, engineering and land acquisition, mainly in Terronera del Oeste, a silver and gold mining district in southwest Jalisco, approximately 155 kilometers southwest of Guadalajara, provided they can obtain financing. “The Terronera property surrounds the small Santa Quitéria mine and represents a new opportunity in terms of exploration and extraction of silver and gold at the district level for Endeavour,” says Cooke.

The company estimates that its silver production will represent between 4.9 and 5.3 million ounces, while its gold production will be between 47,000 and 52,000 ounces.

Endeavour Silver has four projects in the exploration phase in Mexico: Terronera; Guadalupe y Calvo, an advanced silver and gold exploration project in the historical mining district of Guadalupe y Calvo in the state of Chihuahua; Endeavour owns El Co-meta, a property of 37 hectares in the historical silver district



In 2003 the company began with two people and an idea. Today Endeavour Silver employs nearly 1,700 people.

of Parral, Chihuahua, which has produced, according to government records, more than 250 million ounces of silver; and the silver and gold property named Lourdes in the Sierra El Cubo, which lies forty kilometers northeast of the city of Guanajuato.

HUMAN RESOURCES, SUSTAINABILITY AND COMMUNITY

The environmental protection policy applied by Endeavour Silver articulates its commitment to prevent or mitigate as far as reasonably possible the impact of mine exploitation in the environment, while improving efficiency in the use of natural resources—such as land, water, energy, etcetera—, reducing waste and improving waste recycling through effective, efficient, equitable and scientifically correct policies and practices.

The company's goal is not only to comply with local laws and regulations, but also to surpass them when possible, focusing on sustainable development and the adoption of best environmental practices. “We maintain constant

two-way communication with the communities near our operations, we address their concerns, we initiate programs supporting common action, and we inform them about the environmental impact of our operations,” explains the CEO.

Endeavour Silver employs almost 1,700 people in the three mining sites it operates in Mexico, with a managing office in León, Guanajuato, plus its main office in Vancouver, Canada. The company creates job opportunities in each mine. “We put special emphasis on hiring people from local communities in order to ensure that both the company and the community together can enjoy the benefits of our operations as well as our success in the long term,” says Cooke.

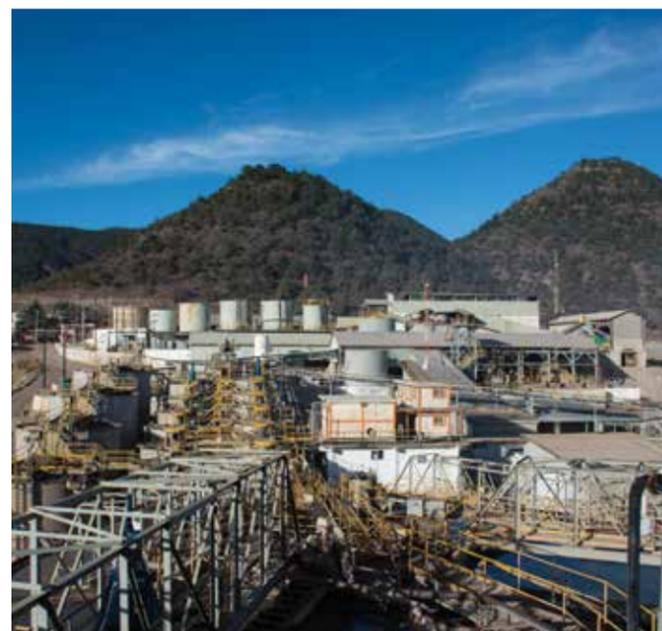
But not only that: they also attract and retain qualified employees. It is an essential policy for the operational stability and sustainability of the company. “We offer competitive salaries and benefits: significantly above the local minimum wage, as well as generous bonuses for productivity

and safety. Likewise, we offer salary premiums for working in remote locations, where appropriate,” says the CEO.

Cooke says growth with integrity means acting responsibly and being good neighbors. “We do our best to maximize the benefits of our activities by building relationships with community leaders, identifying local needs and committing to a dialogue on how we can build capacity and improve measures of social performance,” he says.

The company also makes every effort to minimize or mitigate the negative effects that its operations may have in these communities. “Our solid approach to community engagement facilitates open lines of communication and dialogue, and contributes to the creation of trust and development of our reputation for integrity with our stakeholders in the community, in order to maintain long-term social approval to carry out our operations,” Cooke concludes. **N**

sp.edrsilver.com



STARCORE INTERNATIONAL MINES CUTTING-EDGE METHODS IN PROCESSES

With little more than a decade in Mexico, this company operates three mines in the country and is constantly seeking new opportunities.

INTERVIEW WITH ROBERT EADIE, CEO STARCORE INTERNATIONAL MINES, BY RODRIGO CANSINO

Robert Eadie, CEO, President and Director of Starcore International Mines has been very active—for over two decades—in companies that work with public resources, raising over 100 million dollars in capital for several development and exploration projects around the world. His performance as a link between investors and businessmen has opened many opportunities for him. The most recent one in a mining company that operates in three locations in Mexico and that he manages from Mexico City.

Currently, the operations of the principal mines have little to do with the past, when they depended on rudimentary methods and tools. Exploration, for example, now involves techniques with satellite support and modern instruments. Starcore International Mines (TSX:SAM) has access to the most modern technologies for extracting gold and silver in Mexico since 2006, in three locations: Querétaro, Sonora and San Luis Potosí.

“The business is growing and the company has brought

technology and investment. SAM has approximately 40 suppliers representing foreign companies in, for example, security technology,” explains Eadie. The levels of investment exceed 100 million dollars accumulated in nearly a decade in Mexico. “And in the last three years, investment has grown by about 75%.”

The mining company has focused on the fundamental aspects of the exploration and production model to establish a portfolio that provides the basis for growth. With strate-

gic operations across North America, SAM's activities range from exploration to production to metal processing.

About 27% of the Mexican territory has been explored in detail, so there is a big opportunity for developing future projects. Mexico is a leading producer of silver and, year after year, it places 12 to 19 minerals within the top ten worldwide. Canadian companies, such as SAM, respect the environment, the traditions and cultures of the peoples where they are established, and provide significant resources to the country's treasury.

THE MINES IN MEXICO

In Querétaro, SAM owns the San Martín mine. The site operates since 1993 producing 350 tons per day (tpd) and currently reaches 850 tpd. The mine was acquired by SAM in 2008 from Goldcorp. The historic production of the mine is over 600,000 gold equivalent ounces, and is set on an area of almost 13,000 hectares.

The Altiplano processing plant is located in Matehuala (San Luis Potosí). This plant will focus on providing advanced processing for precious metals to many small and medium producers in the immediate area, generating income based on services such as treatment and refining, among others. A process of dissolution, such as that offered at Altiplano, provides a cleaner and less costly casting technology for treating concentrates,

compared to other options in the area.

The Matehuala plant is designed to process 25 tons per day with 90 hours of chlorination, with capacity of increasing it to 50 tpd. Matehuala has approximately twenty small and medium mining companies that consistently produce high-grade concentrates. Fine silver and gold are obtained as sub products; the lead and copper concentrates, together with the remains of gold and silver, are sub products sold to smelters and traders.

In February of 2015, Starcore International Mines, through Crestón Moly Corp., acquired 100% of the El Crest-

ón property, which is 5.5 kilometers long by 1.5 kilometers wide trend, with hydrothermal alteration, where several zones of molybdenum, copper and silver mineralization are located. El Crestón Principal / El Cerro Zona Roja is a large deposit of molybdenum and copper. Additionally, there are five other areas with potential that could carry important molybdenum and copper resources.

HUMAN RESOURCES AT SAM

“Young Mexicans are an excellent workforce, but they must be trained and prepared for work,” says Eadie. This year SAM has the challenge to re-

The mining industry in Mexico is still young and requires government stimulus to foster its growth.

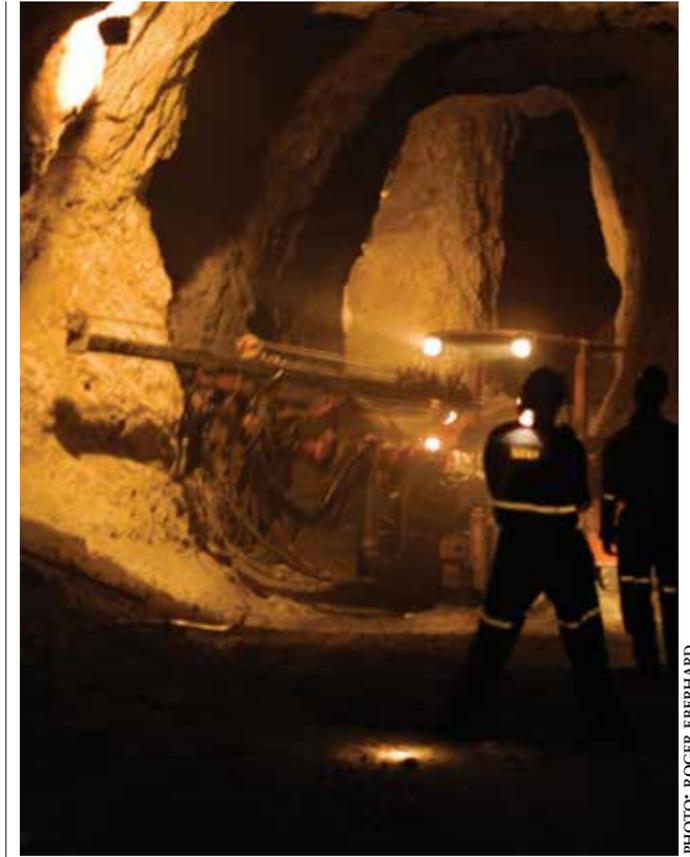


PHOTO: ROGER EBERHARD



PHOTO: ROGER EBERHARD

cruit staff with job skills, as well as deal with the price of gold. In other years the challenges have been different. For example, several years ago they had to negotiate with the miners union and prior to that the mine had operating difficulties.

One of the anecdotes that Eadie recalls is that in 2015 the government had problems with a mercury mine and had asked them for help. “We went with our technology to rescue two miners in a cave because that mine they didn't have the ad hoc security equipment to operate it.”

From Eadie's perspective, the energy reform will attract foreign companies that will bring more technology. “Although we are not in the energy sector, we will benefit from companies that will bring drilling equipment and train technical personnel to operate it. Also,

we will win by having access to parts and qualified personnel. The more knowledge, the more we gain,” sums up the CEO.

In the last years, the price of gold has shown a downward trend. Hence Eadie and his executive team consider they are an important link in the Mexican mining industry. “That is why we have diversified the manufacturing process, we have expanded as a company in order to not depend on the price of gold, but on its extraction and processing,” he explains, while showing complete satisfaction with his Mexican human resources. “The performance of our workforce in Mexico is excellent, basically in its commitment to the job. And it constantly improves, as younger workers acquire more skills and the desire to work.” **N**

www.starcore.com



PHOTO COURTESY OF STARCORE INTERNATIONAL MINES

TOREX GOLD RESOURCES CONVERTING THE GOLDEN BELT INTO A SAFE PLACE

One of Mexico's largest regions of precious metals is shining internationally, not only because of its deposits but for its reinforced security, thanks to the teamwork of the government, the community and the mining companies that could convert it into an investment hub.

INTERVIEW WITH FRED STANFORD, CEO, TOREX GOLD RESOURCES INC., BY CAROLINA RUIZ

The opportunity that Fred Stanford, CEO of Torex Gold, found in the state of Guerrero was not only the growth of the Limón-Guajes deposit into a precious metals mine, but also the teamwork of the government, the community and the mining companies to convert the Golden Belt of this region into a safe place, ready to host and develop projects worth billions of dollars.

Torex Gold is a Canadian mining company that has so far defined two deposits in the region. First one, El Limón-Guajes mine, built to reach a production capacity of 14,000 tons per day, involved an investment of 800 million dollars.

After the two-year build, the mine started gold production in December of 2016 and is on track to reach commercial production before the middle of this year. "The plant is ramping up

as expected and is in very good shape," says Fred Stanford.

The second project, Media Luna, only seven kilometers away is at an advanced stage of exploration and a positive PEA was completed last year. Media Luna could become the second mine, an underground mine producing gold, silver and copper concentrate. "We look forward to many years of mining in the area."

THE MEDIA LUNA PROJECT

The acquisition of the 29,000 hectares of the Morelos Property in 2009 from Teck came with an estimated resource of three million ounces of gold. Further exploration and development work at the El Limón-Guajes deposit over the next four years, made possible the growth of the resource and the feasibility of the mine development. In 2012 Torex an-

nounced the discovery of its second deposit, Media Luna. "The second project, Media Luna, is only seven kilometers away and it will be our first underground mine here," explains the CEO of Torex Gold.

At present, Media Luna is in its preliminary stage: "We still have much exploring to do. The project will use innovative technology and will become one of the largest mines in the country, and has the potential to become a mine for generations to come. The capital required to build this second mine is approximately 450 million dollars," he says.

According to Stanford, the success of both projects will not only come from the very wealth of the deposits where they operate, but from the co-operation and teamwork that Torex Gold is developing with the government, regulators,



banks, investors and communities, which he qualifies as one of the existing treasures in the region. Planning is so meticulous that the time invested by everyone is treasured and measured, as any precious metal. "We are very committed to the region and inject lots of energy in planning for the future," says Stanford.



TOREX GOLD IS A CANADIAN MINING COMPANY

- **CEO:** Fred Stanford
- **First project:** El Limón-Guajes, Cocula municipality, state of Guerrero, Mexico.
- **Investment in Mexico:** 8 million dollars.
- **Start of production:** 2015. Annual throughput: 14,000 tonnes per day.
- **Second project:** Media Luna. Underground mine. State of Guerrero, Mexico.
- **Potential Investment:** Approximately 450 million dollars.

According to the Torex Gold CEO, the agreements in the Golden Belt may result in more sound private mining and other investments in the measure that the region becomes a safer place for investments and work opportunities for the communities in the area.

BIG DEALS

In September, Torex Gold participated in signing an agreement in which federal, state and local authorities were also

involved, in order to ensure the safety of the communities in the areas adjacent to the Morelos property.

"All the companies in the area were involved in the

discussions, which first took place with the authorities, and several military commanders were also involved, and at the end of the day the consensus was to understand the needs of the community," explains Stanford.

The signing of the agreement was held in Acapulco, Guerrero, and among the established points, controls were set to guarantee the security of the communities and all those working in the area.

RESPONSIBLE MINING

One of the premises of Torex Gold's business is responsibility: financial, social and environmental. This philosophy is applied to all the resources that the mining company works with, closely monitoring

its activities with the environment and the stakeholders in the project, from shareholders, bankers, government, staff and communities.

Innovative technology will ensure adherence to strict environmental standards and safety regulations. The RopeCon, a suspended conveyor will bring the ore over a 400 metre drop, thus avoiding risks of trucks going up and down the hill. Also, the tailings filtration facility is the largest in the world with seven parallel filters that will allow the recirculation of water and the safe disposal of dry stack tailings.

"People working together can make beautiful things," concludes Stanford. **N**

www.torexgold.com

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GOLDCORP TECHNOLOGY FOR MINING

This company is the number one producer of gold, silver, zinc and lead in Mexico, representing a major impact on the metal-mining industry.

INTERVIEW WITH MICHAEL HARVEY, REGIONAL DIRECTOR, CORPORATE AFFAIRS AND SECURITY, GOLDCORP LATIN AMERICA, BY PROMÉXICO

Since 2005 Goldcorp began to make a major change in mining production in Mexico and today remains as one of the main producers. The company is also present in Canada, Guatemala, Argentina, in addition to a joint venture in the Dominican Republic and a major project in Chile. It is one of the top four companies that produce gold and silver in the world, and its most important mine, Peñasquito, in Zacatecas, achieved record production in 2015.

With the arrival of Goldcorp to Mexico, it developed Peñasquito, Los Filos and it joined El Sauzal. "We can say that the company has promoted two projects that have been successful: Camino Rojo is another project that is under analysis, and we're awaiting the results of exploration to evaluate them and then define a strategy, because this is a project with great potential," says Michael Harvey, Regional Director, Corporate Affairs and Security, Goldcorp Latin America.

STATE-OF-THE-ART TECHNOLOGY

There has been an emergence in global positioning technologies applied to mining. In fact, the GPS system was born as an application for the transportation and mining industries. In Mexico this technology has had an impressive development because the country has gone from underground mining to open pit developments. This has required new technologies and one of them has been global positioning, better known as Dispatch, a

system that allows making decisions in real time to optimize the fleets of shovels and trucks, because the mobilization of material with this equipment is one of the most expensive steps in the process of extraction.

Drones are another technology that Goldcorp uses in combination with other topographic survey equipment, at the Los Pinos and Peñasquito mines. The traditional figure of the topographer, that would walk upon a surface with his hand-held device while an as-

sistant would signal a certain point with a marker, measuring different angles and distances, has become a thing of the past.

"Other technologies that we are using at Peñasquito are geotechnical monitoring systems; that is, radars that serve to learn about the status of the geology and geotechnical quality of the mine cut, because the walls are over 400 meters high and we have to be careful and sure of their stability. This radar constantly scans the walls of the cut in order to detect even

millimetric movements among the particles that form it, so that if something moves beyond a certain range, it immediately sounds an alarm that warns us that we have to pay special attention to a certain area of the mine," explains Harvey.

The expected projects at Goldcorp in the next three years include the Peñasquito mine. There they are working on a special project to process material that is not exploited and contains lots of pyrites, and where they can find concen-

Drones are another technology that Goldcorp uses in combination with other topographic survey equipment, at the Los Pinos and Peñasquito mines.



trations of lead and zinc. "Today, because our plant does not have the ability to float sulphides of iron, that material simply passes through our process. By implementing a pyrite plant we will be able to increase production with the same material we are currently producing," says Harvey.

BENEFITS OF THE ENERGY REFORM

For three years Goldcorp has handed out Global Excellence Awards, with the aim of encouraging and capturing ideas generated at all levels of the organization, especially among those who better understand the challenges facing mining: the workers who are in charge of the production stages at the company.

These internal awards intend to invite the company's contributors to generate new ideas, because for Goldcorp the most important asset is its people. "The contributions made by all of them help us better analyze the way we do things, but above all how we can improve them," says the Director.

Goldcorp started very early with energy projects. "We have signed an agreement with a company that has allowed us to improve our costs. We started in 2015 and the result has been very effective, because we have decreased our costs. In that sense, the energy reform has helped us," says the Goldcorp executive.

The opportunities perceived by Goldcorp regarding the energy reform focus on ob-

taining more competitive prices, even "analyzing the possibility of generating our own energy, either wind or solar, as long as they continue advancing in the legislation that has been triggered by the energy reform. We need to move to the next level of legislation to make it economically feasible."

One of the company policies is to generate sustainable value in the areas where it operates. In this sense one of its first criteria is to seek alliances with local suppliers, with competitive prices and services. "We have many local, regional and national suppliers, in many branches, from food products and heavy machinery, to transportation services to and from our camps, among others," describes Harvey.

A SUSTAINABLE COMPANY

The industry could operate better if more attention were placed on the whole productive chain of the mining industry, says the Goldcorp executive: "In ports, for example, there have been various efforts to build industrial ports that haven't materialized, which explains why maritime trade has not developed fully. And this is the way that the mining industry moves its concentrates." For the time being, the option is to operate through the available ports. Inland ports would also be helpful to expedite the movement of the industry's inputs.

The El Sauzal mine is closed due to the depletion of its reserves. One of the technologies that Goldcorp adopted since the start of the closing process was drying metallurgical waste. Instead of moving the pulp to the tailings dam where water is lost through evaporation, the queues are filtered before they leave the plant, so they arrive at the final deposit with a minimum quantity of water. This way, all the liquid is recovered and is redirected into the process. This significantly reduces the quantity of water used in the process. Secondly, it makes the deposit much more sustainable because it's stable from the beginning.

"Another way in which we seek sustainability is by including the adjacent communities into our operations in productive processes that are not necessarily linked to the mining activity as such, so that when a mine is depleted and the job is finished, the community can continue on with other economic activities. All our units promote various projects to help sustain these communities," concludes Harvey. **N**

www.goldcorp.com

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SILVER STANDARD RESOURCES MANAGING THE SECTOR CRISIS CALMLY

Mining in Mexico is in a process of conversion to modern methods of extraction and mineral processing. Unfortunately, only large and medium companies have access to this conversion. Many small miners and family businesses are still using old methods and previous generation equipment for their processes.

INTERVIEW WITH CÉSAR HERRERA, COUNTRY MANAGER IN MEXICO, SILVER STANDARD RESOURCES, BY RAQUEL RIVAS

Since its founding in 1946, Silver Standard Resources has played a leading role in the global mining industry, first in prospecting and exploratory drilling, and in this new century as a company specializing in mine construction and operation. “We’ve been in Mexico since 2004 searching for world class projects to explore and develop,” says the company’s Country Manager in Mexico, César Herrera.

The company has managed to become one of the leading licensees in mining funds in the country, with a total of 319,000 hectares in fourteen exploration projects. However, with the fis-

cal reform that affected exploration companies, as well as the significant increase in annual rates of entitlements per hectare, Silver Standard Resources decided to transfer 307,000 hectares. “Now, in 2016, we only have 12,000 hectares in eight projects.”

The executive also notes that mining in Mexico is in a process of conversion to modern methods of extraction and mineral processing. Unfortunately, only large and medium companies

have access to this conversion. He explains that many small miners and family businesses are still using old methods and previous generation equipment for their processes.

HAND IN HAND WITH THE GOVERNMENT

According to the Country Manager, the Mexican environmental laws are on a par with those of any advanced country in the world. He stresses that the Secretaría de Medio Ambiente

y Recursos Naturales (Semarnat, Secretariat of environment and natural resources) and the Comisión Nacional del Agua (Conagua, National water commission) are two of the most efficient government agencies in the country. “Mining companies have been concerned with increasing their standards of quality in managing their environmental processes, even above the current legal framework,” says Herrera, who adds that in Mexico managers and

“Mining companies have been concerned with increasing their standards of quality in managing their environmental processes, even above the current legal framework.”



According to Herrera, Pitarrilla—in the state of Durango—requires around 2.5 years to build and to produce its first marketable ounce of silver. Therefore, “we are waiting for more favorable fiscal, labor and market conditions in order to operate our mine.”

employees take the environment very seriously as well. Awareness among families and mining communities is a fact, and the sector has invested heavily in this in the last decade.

But the proper practice of the sector is not only centered on its relationship with public agencies. The high level of skilled labor is equally a key in market growth. The executive states that in the most recent era of the mining industry, others professionals have entered the sector once the industry has begun its process of modernization and the socialization

of its activities. Such is the case of social anthropologists, environmental system and water system managers and engineers, specialists in robotics, quality system technicians and human development graduates.

“In our experience, we have found a sufficient supply of professionals in all branches, who have been available for hire.” The respondent states, however, that a great deal of this labor does not necessarily come from recently graduated university professionals, but from lateral mobility between mining companies.

WORKING TO OVERCOME CHALLENGES

Silver Standard Resources has faced different challenges that affect the industry at a global level, such as low metal prices. For this reason, the management was forced to temporarily suspend the development of their Pitarrilla project. Despite this, the company is positive regarding the near future.

According to Herrera, Pitarrilla—in the state of Durango—requires around 2.5 years to build and to produce its first marketable ounce of silver. Therefore, “we are waiting

for more favorable fiscal, labor and market conditions in order to operate our mine.” It is important to mention that, even with this suspended project, Silver Standard Resources has promoted the development of suppliers in the region and is a leader in the creation of a mining cluster in the state of Durango, while replicating positive experiences in other states like neighboring Zacatecas.

Currently, the firm is seeking economic alternatives for its development and construction. The executive notes that they have already begun a feasibility study to begin exploitation in an underground mine, and are expecting better conditions for the development of an open pit mine. Simultaneously, Silver Standard is still seeking serious opportunities for acquiring an already operational mine or developing a second mine in the next three years.

Furthermore, mining itself represents big challenges, due to high expenditures in prospecting and seeking projects in remote locations; geological, metallurgical and financial studies; a constantly changing world market; the cost of inputs and the global availability of equipment. Add to this the lack of a secure legal framework for obtaining the surfaces required for exploitation, tax authorities that don’t know the industry and a sector fragmented into companies of different sizes. “Mining companies must face all these challenges when arriving in a new country.”

Silver Standard is, in the words of its Country Manager, a company with solid finances. The economic and the commodity price crises represent an opportunity for seeking new mining investment projects. **N**

www.silverstandard.com

CYPRIUM MINING CORP. A TRADITIONAL COMPANY

Over the last three and a half years the company has invested over \$2 million in the state of Chihuahua to advance our mining projects. We estimate that over the next two years we will invest a further \$2.5 million.

BY ALAIN LAMBERT, CEO AND CO-FOUNDER, CYPRIUM MINING CORP.

Cyprium Mining is a Canadian company with operations in the State of Chihuahua in Mexico. Cyprium acquires, operates and develops past producing mines located in Mexico. When selecting projects, Cyprium has as key criteria the possibility of the mine being brought back into production in the short-term and the mine having significant exploration potential.

The company utilizes traditional, proven small-scale production techniques in the short-term to generate cash flow. This cash flow will in great part fund the systematic development and exploration of the mine through modern equipment and techniques.

Cyprium is committed to maximizing the potential of these projects by funding exploration programs mainly through

cash flows generated by production instead of funding such programs strictly through equity offering thus limiting shareholder dilution. Cyprium prioritizes projects which are easily accessible and close to large urban centers.

Over the last three and a half years the company has invested over \$2 million in the state of Chihuahua to advance our mining projects. We estimate that over the next two years we will invest a further \$2.5 million. The majority of

these funds will be used to re-start the historic Potosí silver mine located in the Santa Eulalia district which has produced over 500 million ounces of silver over the last one hundred years.

In late 2015, Cyprium announced that it has closed the acquisition of a 53% controlling interest in a joint venture which owns the exclusive exploitation and exploration rights of the Potosí silver mine located in the historic silver rich mining district of Santa

Over the next couple of years, the joint venture will carry out two principal projects. The first project is the rehabilitation of shaft #3 of the Potosí silver mine. The second project of the joint venture involves the rehabilitation of the larger and deeper shaft #5 of the Potosí silver mine which will provide access to all levels of the mine down to level eleven.



Eulalia in Mexico; the exclusive rights of possession, usage and operations to the San Guillermo processing facility which is located seven kilometers from the Potosí silver mine; as well as all of the exclusive exploration and exploitation rights to a property adjacent to the south of the Potosí silver mine known as La Chinche. Cyprium's partners in the joint venture are entities controlled by members of Mr. Daniel Valenzuela's immediate family. Mr. Valenzuela is a third generation miner located in Chihuahua, Mexico, whose family has owned the joint venture assets for over sixty years.

Over the next couple of years, the joint venture will carry out two principal projects. The first project is the rehabilitation of shaft #3 of the Potosí silver mine. The goal of this project is to gain access to mine levels 3, 4 and 6 where the Potosí Partners last mined between 2010 and 2012. Once production resumes, Cyprium intends to send the mineralized material extracted through shaft of the Potosí silver mine to the Cyprium's Aldama plant.

The second project of the joint venture involves the rehabilitation of the larger and deeper shaft #5 of the Potosí

We have been active in Mexico since 2012, and all this time, our experience in working with the local, state and federal environmental authorities has been collaborative and positive.

silver mine which will provide access to all levels of the mine down to level eleven. The rehabilitation of shaft #5 is expected to take about ten months. Once the shaft is rehabilitated, the initial exploration and production will focus on levels nine and ten where the most recent exploration activities have taken place.

Rehabilitation of the San Guillermo processing plant is not planned until mid to late 2016. The timing and final technical plans for this rehabilitation will be dependent on

expected production at that time, and the capacity available at the Aldama plant. Santa Eulalia is a world class polymetallic mining district located in the central part of the State of Chihuahua, Mexico, approximately twenty-two kilometers east of the City of Chihuahua. Mineralization in the area was originally discovered during the Spanish colonial period in the 1500's, and recorded production has occurred over more than 300 years. Santa Eulalia ranks as one of Mexico's primary silver and base metal

producing districts with nearly 500 million ounces of silver and substantial amounts of lead and zinc mined. The nature of the deposit in the Santa Eulalia district is a carbonate replacement deposit and is the historically largest of its type in Mexico. Mineralization occurs in an area about ten km in length and five km in width. Production and reserves for the district have been estimated to be about fifty million metric tons with grades of 125-350 g/t Ag, 2%-8% Pb and 3%-12% Zn, along with appreciable quantities of tin and vanadium.

We have been active in Mexico since 2012, and all this time, our experience in working with the local, state and federal environmental authorities has been collaborative and positive. We have found officials to be both sensitive to the needs of the mining companies but also act in a way that is within the regulatory framework which make the environmental process predictable and efficient. **N**



www.cypriummining.com

MEXICAN MINING PREPARES FOR A BETTER GLOBAL ENVIRONMENT

Mexico is a country with high mineral potential. Mining is present in 25 of the 32 states of the Republic, and is an engine of economic development for the country. Almost 70% of the national territory has geological development potential, since it has expanses of land that are undoubtedly rich in minerals.

BY SERGIO ALMAZÁN ESQUEDA*, GENERAL DIRECTOR, CÁMARA MINERA DE MÉXICO (CAMIMEX, MINING CHAMBER OF MEXICO)

The weakness of China's economy, low oil prices and the appreciation of the US dollar have had an impact on most economies in the world and point to lower rates of economic growth. The outlook for the medium and long term varies according to the specific development in each country, as the global recovery continues to be affected by unexpected challenges such as geopolitical conflicts in different regions of the world. In the case of Mexico, the mining industry maintained high and sustained growth for nearly a decade, but the fall in the prices of minerals, a higher tax burden and the international economic downturn, originated negative trends from 2013 to date. The entry into force of the tax reform in January of 2014, which involved the payment of additional duties to the mining sector, has reduced interest in Mexico compared to other mining countries, since the tax measure took place during a period of low international prices of minerals, impacting the competitiveness of the industry.

Thus, the application of new mining rights and the elimination of the tax deduction of exploration expenses in the year they are made accentuated the fall of the principal mining indicators: 2014 and 2015 were difficult years. In 2014 the price of gold fell 10% compared to 2013, and 8.4% in 2015, compared to the previous year; in these periods, silver fell 20% and 18%, respectively, while copper fell 6% and 20%.

The value of mining-metallurgical production in 2014 decreased 5% compared to 2013 and almost 12% in 2015 with respect to 2014, down to 13.5 billion dollars. Investments remained at a level of 5.2 billion dollars in 2015.

There is confidence in the sector that in the second half of this year the market conditions will improve. Despite the negative trend of mining commodities in the in-

ternational arena, production, expansion and exploration projects initiated during the high-price cycle will continue. However, the industry is expecting that the demand and prices of minerals will recover.

HIGH MINERAL POTENTIAL IN MEXICO

Mexico is a country with high mineral potential. Mining is present in 25 of the 32 states of the Republic, and is an engine of economic development for the country. Almost 70% of the national territory has geo-

logical development potential, since it has expanses of land that are undoubtedly rich in minerals.

The mining sector in Mexico presents many opportunities that should be exploited, such as its strategic geographical location, skilled workforce, world-class mineral deposits, community relations, security, institutional strength and legal certainty with the application of regulations and transparent procedures that justify investment in the sector.

In December of 2013 there were 267 companies in Mexico that were developing 870 projects. By 2014, the Ministry of Economy reported 902 mining projects, of which 129 were postponed or delayed.



EFFICIENCY AND COST REDUCTION, ESSENTIAL FOR COMPETITIVENESS

The members of Camimex know that the ups and downs in the international mining industry are cyclical and that they should patiently await changes. Meanwhile, they are working to increase the efficiency of their operations and competitiveness.

In December of 2013 there were 267 companies in Mexico that were developing 870 projects. By 2014, the Ministry of Economy reported 902 mining projects, of which 129 were postponed or delayed. Given the drop in metal prices, companies are improving their processes and reducing operating costs, while caring for and improving the security and working conditions of their staff, as well as the environment. In order to achieve this they have adapted new technologies in actions such as:

- Remote operation of trucks in open pit mining with rollover protection cabins.
- Use of renewable energy to reduce production costs.
- Care for personnel in remote locations by using telemedicine and including software for conducting studies, evaluations, diagnoses and consultations that allow the creation of sensitive medical records to be sent from a distance.
- More precise studies for slope stability, through interferometric geo-radar.
- Dust control suppressants that function by modifying the physical properties of the surface, improving air quality and visibility on the road.
- Bio-remediation and phyto-remediation of soils, water treatment, disposal and recovery of metals in waters, among other applications.

Camimex affiliates also have budgets for making the industry sustainable. They comply with national and international standards that guarantee the care and protection of the environment before, during and after their production processes. The mining industry is committed to the healthy coexistence of people and ecology, as well as seeking social benefits for the communities where they operate. Proof of this is that in 2014 the mining industry spent 1.1 billion pesos to the preservation of the environment, and another 1.0 billion pesos to community development.



Camimex has consolidated as the governing body of the mining sector and represents the general interests of the country's mining and metallurgical industry.

CAMIMEX, SYNONYMOUS WITH UNITY

In adverse moments or prosperity, Camimex supports its members. It groups, coordinates and represents the mining and metallurgical industry before the different levels of government and other agencies. It also provides information, training, management services and support for promoting the comprehensive development of the industry.

It has a relationship with government agencies such as ProMéxico, to coordinate the promotion of investment in the sector in both the domestic and international arenas. With this institution and the Ministry of Economy, it has strengthened the synergy for complying with common goals. One delegation of miners traveled to Chile to analyze and evaluate business options. Another delegation participated in the Shanghai 2010 World Expo, where for the first time a Mexican pavilion was set up and devoted to the mining industry for a whole week (from June 6th to 13th). In 2012 it participated with investments in the mining and port sectors.

Thus, Camimex has consolidated as the governing body of the mining sector and represents the general interests of the country's mining and metallurgical industry. It encourages its development, ensuring

access of its members to programs targeted for the development of trade in the sector.

The support provided by Camimex extends to the creation of a larger number of professionals that specialize in this sector. Given the need and shortage of graduates in mining engineering, in 2008 it established a trust to support students pursuing engineering careers in Earth Sciences from companies affiliated to the Camimex.

In 2013, when the fall in metal prices began, the process of hiring graduates continued. In 2015, 114 scholarships were awarded to 75 students and 39 teachers. However, if this downward cycle that intensified in 2015 persists, we have no doubt that employment opportunities could stall significantly and could even spur an oversupply of professionals. That is why we hope that, by mid-2016, the international market will show signs of a turning point that will lead to the recovery of the mining industry. **N**

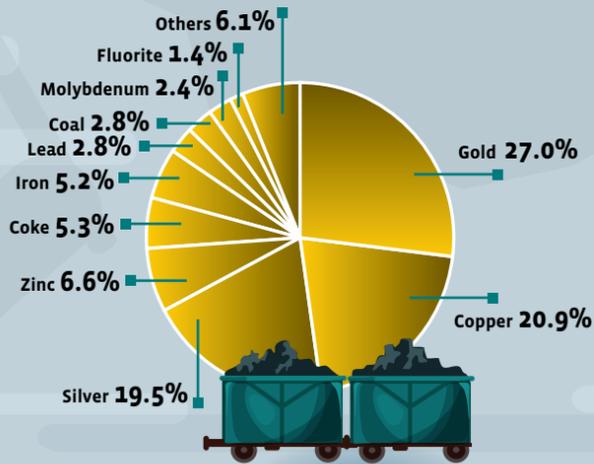
www.camimex.org.mx

* The author is a geological engineer graduated from the Instituto Politécnico Nacional (IPN, National Polytechnic Institute)

MINING IN MEXICO

Mexican mining has seen high and sustained levels of growth for almost a decade. In 2014 the share of **mining and metals** represented **8.9% of the Industrial GDP** and **3% of the national GDP**, according to data from INEGI's 2008 System of National Accounts.

PARTICIPATION OF METALS AND MINERALS IN THE VALUE OF MINING AND METALLURGICAL PRODUCTION 2014
(196.9 BILLION PESOS)



Source: INEGI

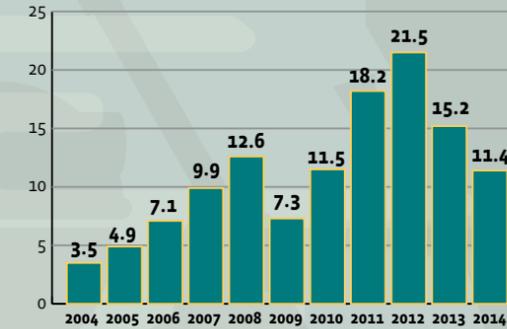
EMPLOYMENT IN THE MINING AND METALLURGICAL INDUSTRY
2003-2014 (THOUSANDS OF PEOPLE)



Source: IMSS

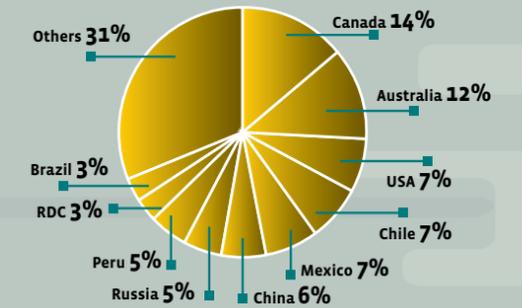
MINING IN THE WORLD

MINING EXPLORATION IN THE WORLD
2004-2014
(BILLIONS OF DOLLARS)



Source: SNL Metals & Mining

PARTICIPATION IN GLOBAL INVESTMENT IN MINING EXPLORATION BY COUNTRY IN 2014
(11.4 BILLION DOLLARS)



Source: SNL Metals & Mining

INDEX OF INVESTMENT ATTRACTION
(THE BEST POSITIONS)

| WORLD | | LATIN AMERICA | |
|---------------------|----------------------|---------------|----------------------|
| Location | # of places vs. 2013 | Location | # of places vs. 2013 |
| 1 Finland | +3 | 1 Chile | -1 |
| 2 Saskatchewan | +5 | 2 Peru | +7 |
| 3 Nevada | -1 | 3 Mexico | -2 |
| 4 Manitoba | +9 | 4 Brazil | -1 |
| 5 Western Australia | -4 | 5 Guyana | +2 |

Note: Position on the list / Number of evaluated countries or provinces
Source: Fraser Institute

According to the Index Investment Attraction, Finland is the favorite of investors worldwide. Chile occupies the best position in Latin America.

INDEX OF MINING POTENTIAL UNDER BEST PRACTICES
(THE BEST POSITIONS)

| WORLD | | LATIN AMERICA | |
|-------------------------|----------------------|---------------|----------------------|
| Location | # of places vs. 2013 | Location | # of places vs. 2013 |
| 1 Yukon | +6 | 1 Chile | -2 |
| 2 Nevada | +1 | 2 Peru | +10 |
| 3 Alaska | -2 | 3 Mexico | +9 |
| 4 Northeast Territories | +7 | 4 Brazil | +13 |
| 5 Manitoba | +5 | 5 Colombia | -9 |

Note: Position on the list / Number of evaluated countries or provinces
Source: Fraser Institute

The Index of Mining Potential under Best Practices qualifies the geological attraction of a region, assuming that its policies are based on "best practices"; i.e. independent of any political restriction. In North America, the Yukon territory in Canada occupies the top position, and Chile obtained the best place in Latin America.

INDEX OF POLICY PERCEPTION
(THE BEST POSITIONS)

| WORLD | | LATIN AMERICA | |
|-----------------|----------------------|---------------|----------------------|
| Location | # of places vs. 2013 | Location | # of places vs. 2013 |
| 1 Ireland | +3 | 1 Chile | +8 |
| 2 Finland | 0 | 2 Uruguay | +36 |
| 3 Alberta | +1 | 3 Peru | +4 |
| 4 Sweden | -3 | 4 Mexico | -8 |
| 5 New Brunswick | +2 | 5 Guyana | +9 |

Note: Position on the list / Number of evaluated countries or provinces
Source: Fraser Institute

The Index of Policy Perception is composed of responses to the survey of government factors. Ireland occupies the top position in the world, as does Chile in Latin America.

INDEX OF MINING POTENTIAL UNDER CURRENT PRACTICES
(THE BEST POSITIONS)

| WORLD | | LATIN AMERICA | |
|--------------------------|----------------------|---------------|----------------------|
| Location | # of places vs. 2013 | Location | # of places vs. 2013 |
| 1 Finland | +11 | 1 Chile | -10 |
| 2 Saskatchewan | +2 | 2 Guyana | +43 |
| 3 Terranova and Labrador | -1 | 3 Mexico | +6 |
| 4 Sweden | +4 | 4 Nicaragua | +34 |
| 5 Western Australia | -4 | 5 Uruguay | +54 |

Note: Position on the list / Number of evaluated countries or provinces
Source: Fraser Institute

The Index of Mining Potential under Current Practices is based on the mining potential of a jurisdiction regarding its current policy, which encourages or discourages exploration. Finland is the best country, as it counts on a geological potential in balance with its current policies. Chile occupies the best position in Latin America.

MINING CLUSTERS, KEY TO THE DEVELOPMENT OF THE MEXICAN MINING INDUSTRY

Mining clusters have the power to bring together government agencies, business and academia, joining efforts to facilitate the development of the mining industry.

BY RAQUEL RIVAS WITH INFORMATION FROM INTERVIEWS WITH ROGELIO MONTEMAYOR, PRESIDENT, CLÚSTER MINERO-PETROLERO DE COAHUILA; ALFREDO PHILLIPS, CHAIRMAN, CLÚSTER MINERO DE GUERRERO; MARGARITA BEJARANO, GENERAL DIRECTOR, CLÚSTER MINERO DE SONORA, AND ALBERTO MENDOZA, DIRECTOR, CLÚSTER MINERO DE ZACATECAS

The Mining Development Program 2013-2018, designed by the Federal Government, suggests that creating mining clusters is a priority task in Mexico, as these multi-sector organizations join efforts to strengthen the great opportunities provided by the development of the mining activity in the country and to look after the requirements of productivity, competitiveness and inclusive development.

The Mexican mining industry has played a prominent role in our country's economy, since it has been present in 25 of our 32 states for many years. It is a key activity for our national development. That is why the Federal Government is committed to supporting its consolidation and growth, creating better conditions for investment in each of the stages of mining projects.

Mining clusters have the power to bring together government agencies, business and academia, joining efforts to facilitate the development of the mining industry. The actors involved in this activity are convinced that working as a cluster, integrating private companies, universities, associations, trade chambers and public institutions, will provide the mining value chain to improve the environment and increase competitiveness.

In coordination with their partners, these clusters develop programs and strategies to strengthen the supply services of the sector, training of human resources and care for the environment, among others. In addition, they generate economic development programs to include more companies and local producers in the value chain of the mining sector.

Supply services have become more professional in order to be competitive on price, attention, on-time delivery, certifications and equipment, among others. The mining industry uses the best practices

in the world, investing in equipment and techniques that result in safer use of the mining resources of the country.

CLÚSTER MINERO-PETROLERO DE COAHUILA

Established in early 2014—after months of analyzing the possible changes that the Energy Reform in Mexico would bring—, the Clúster Minero-Petrolero de Coahuila is essentially a relationship body that generates and disseminates information. It is an important vehicle for international companies to build relations with the communities where they will operate, search for and find local suppliers, become aware of the necessary procedures required to properly record their processes in Mexico, and obtain information on the sector for proper decision-making. But also it can be a channel for Mexican suppliers to certify and place their products in the world market, through global tenders offered by the operators that the cluster has or will have contact with.

Rogelio Montemayor, President of the Clúster Minero-Petrolero de Coahuila, explains that this can be considered as a two-way bridge. One way it provides foreign operators interested in participating in Mexico with more certainty thanks to its efficient networking and quality information; the other way is allows Mexican companies and workers to participate in the supply chain of the industry on a global level.

THE STRENGTH OF THE TRIPLE HELIX

Based on the Triple Helix model, the cluster consists of more than forty companies, eleven colleges, three research centers, seventeen municipal governments and the Government of the State of Coahuila. It also is in constant communication with the federal entities such

as the Secretariat of Energy, the Secretariat of Environment and Natural Resources, the National Agrarian Registry, the Secretariat of Agrarian, Land and Urban Development, and the Institute of Management and Valuation of National Property. This collaboration allows for generating greater negotiating capacity with the authorities on the three levels of government, as well as improving the supply of its products and services through training, strategic alliances and high-level networking.

“On the other hand, in order to strengthen our structure, we have established agreements with several global service companies, such as BP, Shell and Weatherford; with business organizations such as Coparmex and Canacindra, as well as other agencies such as the Mexican Institute of Industrial Property (IMPI) and the Federal Commission for Regulatory Improvement (Cofemer),” explains Rogelio Montemayor, who also notes that strong relations have also been built with large Mexican companies like Peñoles and Grupo México.

“The cluster includes more than forty companies from all sectors, some with experience in the mining and energy sectors, and others with the intention of becoming part of the value chain. Practically all of them are Mexican companies; only one foreign company is associated with the cluster.”

ENVIRONMENTAL REGULATIONS ON A GLOBAL SCALE

According to Montemayor, the Mexican government has issued laws, regulations and standards regarding the protection and care of the environment comparable to those of developed countries such as the USA and France, in an effort to keep them up to date and in accordance with the technologies and techniques used today.

PHOTO COURTESY OF CLÚSTER MINERO-PETROLERO DE COAHUILA



The cluster consists of more than forty companies, eleven colleges, three research centers, seventeen municipal governments and the Government of the State of Coahuila.

The executive explains that the mining industry uses the best practices available in the world, investing in state-of-the-art equipment and techniques that result in a better use, with more security—not only environmental—of the country's mineral resources. Some of the big mining companies must comply with high standards and international norms—OHSAS 18001, ISO 9001, ISO 14001, AA1000, IFC norms—, plus the necessary certifications, “if they want their products to be considered by the international industry. Environmental and social programs have stringent requirements that mining companies must meet.”

The President of the cluster recognizes that there is still much to be done on environmental issues, because there continue to be accidents with serious impacts in this regard, “many of them caused by human error and lack of maintenance.” Furthermore, “the agencies in charge of the environmental aspects lack the personnel to supervise all the mining activities in the country.”

TOWARDS THE FUTURE WITH OPTIMISM

Within the cluster they have identified several challenges to overcome in order to ensure that the hydrocarbon industry can develop in an effective way. These challenges are related to specialized suppliers for the sector, training of human resources, infrastructure, protocols for the control and remediation of environmental damage, communication strategies with the communities, knowledge of the legal procedures on behalf of the owners of land, and generation of innovation and technology.

To do this, the cluster, in coordination with its associates, has developed programs and strategies to solve or ameliorate these areas of opportunity. Such is the case of the Strategic Human Resources Program for the State of Coahuila on hydrocarbons, “as well as the agreements we have established with global operators for research and development of suppliers, or the agreement with the Cofemer to introduce a program of standardization in the state and the creation of a system of rapid establishment of companies in the sector,” concludes Montemayor.

www.clustercoahuila.org.mx

CLÚSTER MINERO DE GUERRERO

The mining sector has been historically present in Guerrero, where cities such as Taxco and Iguala depend on this industry. But it still has not discovered its full potential. Besides silver and gold, the state produces other important minerals such as zinc, copper, lead, and iron ore.

The mining industry could become one of the principal, or the main, motor of development in Guerrero, leading the state to move into the top five States nationally in the mining sector.

To do this, says Alfredo Phillips, Chairman of the Clúster Minero de Guerrero, it is necessary that the sector, society, and government work together so that this potential can become a reality. For this reason, they are working on the consolidation of the Clúster Minero de Guerrero, in or-

der to position the mining industry in the state as one of the most important sectors, and in generating a communication strategy to spark the sense of pride among the people of the state.

The cluster focuses on three main topics considered relevant to achieve the full potential of the mining sector in Guerrero. The first seeks to grant full legal and social certainty for mining investments. This means that the government must enforce the rule of law so that the investments that are made in the state have the necessary certainty that mining projects require, and that typically are carried out in periods of ten to twelve years.

“Mining projects, like all extractive industries, are unique in that they are located where the mineral bodies subject to exploitation are, unlike other industries that can decide where to locate depending on an analysis of their economic competition.” With this in mind, explains Phillips, and considering the long periods for payback on mining projects, these are subject to negotiations with the owners of the lands where the federal concessions are located.

On a national level, in most cases, these agreements between the parties are conducted in a fair and equal manner, “but there are situations where the initial agreements are disclaimed once the initial investment has been made, and this exposes the parties to an incorrect situation where the landowners abuse their monopoly power, leading to undue renegotiations that significantly affect the financial development of the projects,” says Phillips.

Sometimes these situations can lead to such damage that the projects must be reconsidered, or even temporarily suspended. “That is why the state of Guerrero must find a formula that allows fair and equitable negotiations so that agreements between the parties are respected in order to achieve the full potential of the sector,” he says.

The second point focuses on strengthening security in the mining region, in order to provide certainty and tranquility to its inhabitants and workers in the mining sector. Recently, the cluster has proposed a model of collaboration between the company and the state so that the parties involved can count on the permanent presence of forces of public order that can provide peace in the communities that mining

regions deserve. “It is essential that the authorities, the community, and the companies work together to guarantee the tranquility of the region where these activities take place, always protecting the integrity of the people and allowing them to work with dignity and create a promising future for themselves,” says Phillips.

Another point on which the cluster is working is the generation of economic development programs that incorporate companies and local producers to the value chains of the mining sector, together with the creation of a Mining Fund that serves as a complementary tool of mining investment.

Alfredo Phillips notes that for mining investment to become a lever of economic and social development for the state of Guerrero, it is necessary for the government, in partnership with the companies and higher education institutions, to create programs that coordinate and use more efficiently the opportunities that corporate spending represents for the creation of local businesses and jobs and for this purpose the Cluster has already launched a formal working group with local business leaders and both State and Federal government officials to develop a working program. At the same time, through the Mining Fund a new opportunity is created for supporting the mining municipalities in the state with complementary resources for infrastructure investment.

“If Guerrero manages to exploit this potential, in six years the contribution of the Mining Fund can exceed 250 million pesos, becoming a great incentive for the municipalities in the area,” concludes Phillips.

CLÚSTER MINERO DE SONORA

Since September of 2015 Sonora can boast its own mining cluster. This excellent news reflects a long-term interest by the mining companies of the state that joined together to promote the development of their activity.

Sonora, being a mining state par excellence—since it is the largest mining producer in the country, representing 24% of the national production value, and as a leader in the production of copper, gold, wollastonite, graphite, anthracite coal and molybdenum—, required the establishment of its own Clúster Minero de Sonora.

“The actors involved in this activity are convinced that work at the cluster

level, integrating private companies, universities, associations, trade chambers and public institutions, will enable us to develop the mining value chain to improve the environment and make businesses more competitive,” says Margarita Bejarano, General Director of the Clúster Minero de Sonora.

The primary objective of the cluster is to join efforts to facilitate the development and linkage of the mining industry in Sonora, so that their activity generates a virtuous cycle that benefits everyone involved. “In this regard, the cluster’s tasks are summarized in linking, facilitating, strengthening and developing all the necessary activities to develop the value chain of the mining industry,” she says.

SONORA, LAND OF MINES

Currently, there are over forty mining operations going on in Sonora, with the participation of Mexican, Canadian, American and Chilean capital, producing copper, gold and silver, primarily, that is exported mainly to Asia, the USA and Europe, and also to South America. “Exports in the sector represent 60% of our total production, and the rest is destined to the domestic market,” says Bejarano, who adds that the state sector employs 105,000 workers.

The country’s largest supply system for mining is located in Sonora: approximately 2,000 suppliers and service providers of different spin, size and capacity are serving the state industry in its requirements. “The mining industry is one of the most observed and regulated, and therefore its

Currently, there are over forty mining operations going on in Sonora, with the participation of Mexican, Canadian, American and Chilean capital, producing copper, gold and silver.



PHOTO COURTESY OF CLÚSTER MINERO DE SONORA

supply requirements must be consistent with the highest standards of quality, price, service and security, to maintain the competitiveness of the sector. There are some technology, tools or equipment requirements that, due to their nature, must be purchased out of state or even from other countries like the USA, Germany, Canada, Sweden, Japan, China, Finland, Australia and Chile, among others. In the past four years we have installed several suppliers and contractors that have brought their service workshops to Sonora; for example, we can mention de cases of METSO and L&H in Cananea, and Atlas Copco in Hermosillo.”

The cluster also represents, in addition to mining companies, other organizations related to the mining sector, universities and chambers such as the Asociación de Mineiros de Sonora, A.C.; the Asociación de Ingenieros en Minas, Metalurgistas y Geólogos de México, Sonora District; the Colegio de Ingenieros en Minas, Metalurgistas y Geólogos de México, Sonora District; the Transformation Industry Chamber, Hermosillo Chapter; or the Universidad de Sonora, and others from different states.

“The work of the cluster committees, led by representatives of the member companies, aims to ensure that the benefits of our activity remain in the state and in the communities where they are generated. At the same time, we host forums to bring together local suppliers and the decision-making side of the companies,” explains Bejarano. To date there have been three mining business meetings with companies the

size of Grupo México and Timmins Gold, and events have already been committed for Minera Penmont and Agnico Eagle.

The director notes that in these business meetings the products and services that companies require are disclosed. “More than 220 businesspeople from Sonora have had this opportunity to do business, while diversifying the pattern of supply of mining companies and promoting competitiveness.”

The Clúster Minero de Sonora is ready to begin a unique training program for suppliers where affiliated suppliers will have access free of charge to a course in safety to standardize criteria allowing them access to the various mining units associated with the cluster, and will also contribute in reducing training costs for suppliers, as well as the costs of training for individual companies, and improve the culture of safety in general.

Additionally, the cluster works on constantly linking the actors involved in mining activities. Last November, for example, within the framework of the visit to Sonora of the Delegation of Commerce and Mining from the Embassy of Sweden in Mexico, the cluster held a seminar on Swedish Experiences in Mining, in coordination with the embassy, Sonora State University and the state government. Several issues regarding security and productivity in mining, equipment, operations and academic experiences in mining were discussed, which generated a participatory environment for exchanging experiences among the more than one hundred attendees and representatives of Swedish companies.

A WORLD OF OPPORTUNITIES

Bejarano points out the benefits of being a member of the cluster: integration to the supply chain of the sector, enrollment in the register of local suppliers for the mining industry of Sonora, and inclusion in the cluster’s exclusive supplier directory. It also provides specialized training programs according to the needs of the sector; and events and campaigns organized by the cluster, such as presentations, courses, workshops, fairs, meetings for suppliers, etcetera. It also offers certification programs for suppliers of the mining industry, direct communication forums with the mining market, funding programs and representation before government agencies.



PHOTO COURTESY OF CLÚSTER MINERO DE ZACATECAS

To date, the cluster brings together fourteen mining units—Mexican and Canadian—and 63 suppliers, of which 85% are Mexican, as well as five government agencies and three educational institutions.

“In addition to universities, associations and institutions, the cluster represents the possibility of participating in the programs that it promotes, as well as generating collaboration agreements and working in an articulated fashion for developing the sector and facilitating the development of specialized human capital for the industry,” concludes Margarita Bejarano.

CLÚSTER MINERO DE ZACATECAS

The Clúster Minero de Zacatecas (CLUSMIN) in a non-profit civil association founded on October 23, 2012 to contribute in developing the mining industry in the region, through joint efforts among mining companies and their suppliers, colleges, government agencies and research centers.

Its basic contributions to the sector have been centered on the development of local suppliers, the attraction of new suppliers to the region, and opening a new professional career that is required by the sector. The CLUSMIN is focused on six key points: facilitating the development of the metal-mining industry in the north-central region of the country; carrying out the necessary actions to attract suppliers to the region; promoting and strengthening the suppliers already established in the state; increasing the indicators of safety and health of the workers; developing the human capital required by the sector; and formalizing the innovation projects and technology development of the suppli-

ers and metallurgical processes of mining companies.

To date, the cluster brings together fourteen mining units—Mexican and Canadian—and 63 suppliers, of which 85% are Mexican, as well as five government agencies and three educational institutions. Alberto Mendoza, Director of the Clúster Minero de Zacatecas, explains that currently the supply chains of the sector are characterized by ups and downs, depending on the services required by the sector. “In the local market there is increasing interaction and in some cases the dependence is high,” he says, and clarifies that suppliers have become more professional and seek to be more competitive on price, attention, delivery on time, certifications, equipment, etcetera. In addition, the government has been sensitized and is supporting suppliers to become more productive, encouraging investment and staff training.

THE PROFESSIONALIZATION OF THE REGION

While Mexico is a major producer of silver and lead in the world, in the region of Zacatecas and adjacent areas, lead, zinc, silver, gold and copper, mainly, are mined. Most of these materials are refined in Mexico and part of the production is exported to the East. Alberto Mendoza emphasizes that 17,000 people work in the mines located in the state, and “35% of the state GDP comes from mining,” he concludes. **N**

www.clusmin.org

MEXICAN MINING CLUSTERS

CLÚSTER MINERO DE CHIHUAHUA*

Affiliates: 73

Mining data in Chihuahua

The mining industry uses only 1.2% of the available water in the Northwest basin. Authorized land use for mining is 0.015% of the total area of the state.

Principal extracted metals

Gold, silver, zinc, copper and lead.

Principal mines in operation

Metallurgical, non-metallurgical and material banks.

* With 2015 data

CLÚSTER MINERO DE SONORA

Affiliates: 27

Mining data in Sonora

Mining in the state of Sonora in recent years has recorded the highest production levels in the country. Metallic minerals such as copper and molybdenum, and non-metallic minerals such as graphite and wollastonite, place Sonora in first place nationally, and the state is the only producer of molybdenum, amorphous graphite and wollastonite.

Principal extracted metals

Gold, silver, aluminum, copper, iron, molybdenum and selenium.

Principal mines in operation

Metallurgical, non-metallurgical and material banks

CLÚSTER MINERO-PETROLERO DE COAHUILA

Affiliates: more than 46

Mining data in Coahuila

The Clúster Minero-Petrolero de Coahuila is a civil association that integrates companies from all sectors, such as municipal and state governments, higher education institutions and research centers. 22.6% of the total surface of the state is under concession for mining.

Principal extracted metals

Gold, silver, antimony, bismuth, cadmium, copper, tin, iron, lead and zinc.

Principal mines in operation

Charcoal and sodium sulphate.

CLÚSTER MINERO DE GUERRERO

The Clúster Minero de Guerrero is in the process of consolidation in order to position the mining industry in the state as one of the most important sectors, and in generating a communication strategy to spark the sense of pride among the people of the state.

CLÚSTER MINERO DE ZACATECAS

Affiliates: 103

(Mining companies, suppliers, government agencies and educational institutions.)

Mining data in Zacatecas

The Zacatecas mining industry, composed of domestic and international companies, is one of the most modern in the country. Zacatecas is the largest producer of silver in Mexico, contributing more than 42% of national production.

Principal extracted metals

Silver, lead, zinc, gold, copper and other products.

Principal mines in operation

Metallurgical, non-metallurgical material banks.

Source: Data provided by the clusters, and data from the Mexican Geological Survey.

IMTA MINING AND ENVIRONMENTAL CARE

The Instituto Mexicano de Tecnología del Agua (IMTA, Mexican Institute of Water Technology) has the infrastructure that allows analytical services and environmental studies at different stages of mine development, such as baseline—physical-chemical, biological and micro-biological parameters, metals and organic compounds, among others, in the water matrix—operation and closure.

BY NORMA RAMÍREZ SALINAS, DEPUTY COORDINATOR OF HYDROBIOLOGY AND ENVIRONMENTAL EVALUATION AT THE COORDINATION OF WATER TREATMENT AND QUALITY, INSTITUTO MEXICANO DE TECNOLOGÍA DEL AGUA

The Mining Development Program (Prodemín) 2013-2018 indicates that the mining industry is the fourth source of foreign currency in Mexico, only after the automotive, electrical and electronics, and oil industries. In its 2014 annual report the Cámara Minera de México (Mexican Mining Chamber) states that Mexico is the world leader in silver production, and is among the top ten global producers of nineteen minerals.

Over the past decade, the main producing states in Mexico's mining sector were: Sonora (25%), Zacatecas (19%), Chihuahua (10%), Durango (8%), Coahuila (4.8%), San Luis Potosí (4.6%), Estado de México (3.5%) and Guerrero (2.6%). Not only does Mexico rank first in world as a producer of silver, but also second in bismuth and eighth in gold.

However, our country still has areas of opportunity for internal work, such as

land ownership/occupation, the new tax regime/mining royalties, community relations, security, institutional strengthening and operating costs¹.

Mining is one of the industries that produces an environmental impact, because during the processing of extracted materials there are multiple risk factors for polluting the environment, both water and soil, reducing biodiversity in the area and causing worker illnesses. The degree of risk depends on the type of extraction that is carried out, either underground or open pit, and the extracted minerals. Regarding water pollution, the mining industry poses a risk to the environment if the processes are not conducted responsibly, especially in the treatment of waste for its potential of leaching.

The mining sector in Mexico has institutions able to support them in the

sustainable management of water and prevent pollution. Due to the strategic relevance of the sector for the development of the country, it is important to strengthen it with scientific and technological tools, as well as technical capabilities to achieve a green, inclusive and sustainable growth.

Mexico has regulations that apply to various aspects of mining, such as the NOM-159-SEMARNAT-2011, which establishes the requirements for environmental protection systems of copper leaching, and the NOM-141-SEMARNAT-2003, that comprises the procedure of characterizing the tailings, as well as the specifications and criteria for site characterization and preparation, design, project, construction, operation and post-operation of tailing dams. There is also the NOM-001-SEMARNAT-1996, which establishes the maximum permissible limits of pollutants in wastewater discharges into national waters and property, among others.

In this regard, the IMTA has the infrastructure that provides analytical services and environmental studies at different stages of mine development, such as baseline—physical-chemical, biological and micro-biological parameters, metals and organic compounds, among others, in the water matrix—operation and closure.

To carry out this work, the IMTA has the Water Quality Laboratory, which analyzes using atomic absorption instruments with hydride generators and graphite furnaces. The first one quantifies the levels of arsenic (As), mercury (Hg) and selenium (Se), among other elements; and the second one quantifies metals whose concentration is of the order of micrograms per liter. Furthermore, there are gas chromatograph mass detectors for identifying and



1 Sampling of macroinvertebrates





Trichoptera, Lepidostomatidae



Diptera, Blaphiceridae

quantifying both volatile and semi-volatile organic compounds.

As part of its services, the IMTA works with mining companies that are committed to environmental preservation, and are involved in monitoring programs to:

- a) Determine the health of aquatic ecosystems;
- b) Quantify the effect of ecological alterations in aquatic ecosystems caused by mining activities;
- c) Determine the environmental stress caused by alterations in mining activities with the use of aquatic bio-indicators;
- d) Generate basic information for non-impacted sites, and follow-up on mining-caused effects;
- e) Discriminate ecological impact vs. no impact;
- f) Determine the ecological health of the aquatic ecosystem through bio-markers and eco-hydrological processes, thereby discriminating the natural variability caused by environmental impact;
- g) Analyze the concentrations of heavy metals in animal tissue and its effect on the food web; and
- h) Connect eco-hydrological processes and discriminate natural biological responses versus effects caused by the impact of environmental management.

Images 1 to 5 present a sampling of benthic macro-invertebrates, the measurement of field parameters and some macro-invertebrates identified in the samples. Bio monitoring can be defined as the systematic use of biological responses, which are

used to evaluate changes in the environment with the ultimate aim of using this information in a quality control program. Images 1 and 2 present a sampling of benthic macro-invertebrates.

Images 3 to 5 exhibit macro-invertebrate organisms from the samples collected in the process of separating and identifying the organisms.

In mining it is important to consider the simulation of pollutant dispersion at the basin level, which will allow us to anticipate the behavior it will have if an

accident occurs. At the IMTA we have created simulation models of pollutant dispersion at the basin level in cases of overflow, where we identify vulnerable areas and the levels of damage to the ecosystems, taking into account at least three scenarios.

For this model we use the Water Quality Analysis Simulation Program (WASP7) EPA, USACE, Tetra Tech Inc., which allows us to interpret and predict the responses of water quality due to natural phenomena and human activity contamination, as well as to manage scenarios for controlling them.

WASP7 is a dynamic model of compartments in aquatic systems, which includes the water column, representing processes of advection, dispersion, point and diffuse charges and border exchanges, pollution charges and water quality conditions at the borders that vary over time.

The institute also has the ability to provide technical assistance in water treatment processes, either for discharges or use in processes involved in mining. **N**

www.imta.gob.mx

¹ Jorge Guadarrama-Yáñez, *Forbes*, México, 2014



Megaloptera, Corydalidae

A NEW APPROACH TO LOGISTICS IN MEXICAN FOREIGN TRADE

Foreign Trade institutions—such as international ports and industrial parks—have adapted to changes in economic, social and infrastructure conditions in the international exchange of goods.

BY JUAN A. PIZANO, LEADING PARTNER OF INTERNATIONAL TRADE AND CUSTOMS, KPMG MEXICO, AND VICE-PRESIDENT OF THE FOREIGN TRADE AND LOGISTICS COMMITTEE, AMCHAM/MEXICO

Mexican foreign trade has evolved over the years. In recent decades it has created and modified so many institutions and legal instruments that being a specialist in a particular sort of operation is not enough anymore. At present it is necessary to have better infrastructure and pillars of support to more fully and effectively undertake various tasks inherent to international trade.

For example, look at the diversification of activities that international ports have

been subjected to, as well as the creation of specific geographical areas for industrial activities, such as industrial parks and, particularly in customs matters, the Recinto Fiscalizado Estratégico (RFE, Strategic fiscal facility) regime.

Industrial parks began to emerge in Mexico in the late 1950s. This figure has evolved according to the needs of various industries, so that a boom was reached in the seventies and eighties as a result of government incen-

tives and the growth of the maquiladora industry. There are currently industrial parks in 23 states, among which the ones in Chihuahua, Estado de México, Hidalgo, Nuevo León and Tamaulipas stand out.

According to the Mexican standard that rules them—NMX-R-046-SCFI-2011—, industrial parks are geographically demarcated and designed to house industrial plants under suitable location, infrastructure, equipment and service conditions, with permanent management for their operation.

The Asociación Mexicana de Parques Industriales (AMPIP, Mexican association of industrial parks) was a pioneer in the

Industrial parks began to emerge in Mexico in the late fifties. This figure has evolved according to the needs of various industries.



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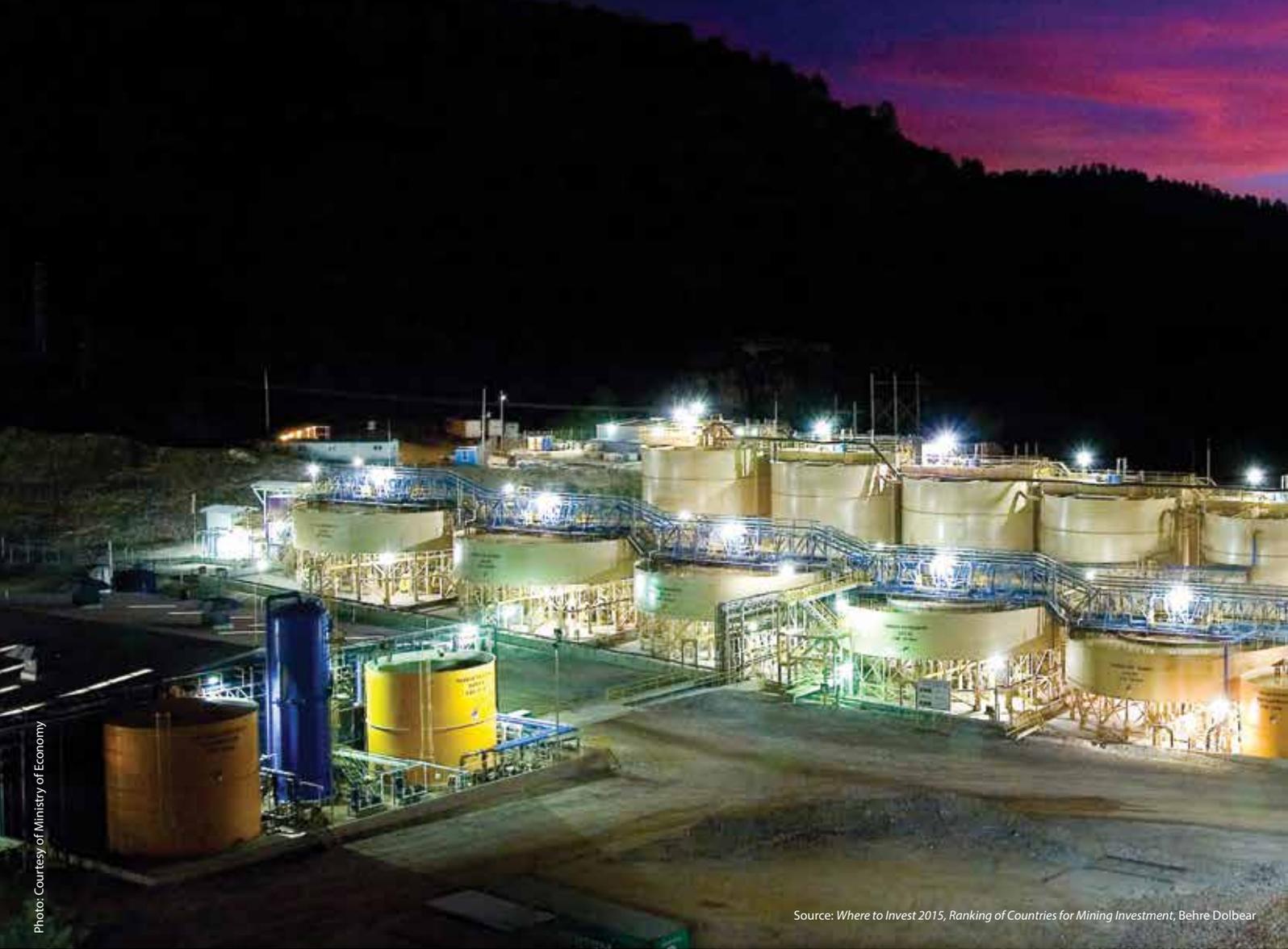


Photo: Courtesy of Ministry of Economy

Source: Where to Invest 2015, Ranking of Countries for Mining Investment, Behre Dolbear

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