



MINES AND PROJECTS > PRODUCING MINES > MULATOS MINE, MEXICO

Our **Mulatos Mine** is our foundation having been acquired for \$10 million in 2003 and grown to become a consistent gold producer and significant cash flow generator. To date, Mulatos has generated more than **\$350 million in free cash flow**.

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## MULATOS MINE ANIMATION



◆◆ SLIDE TABLE

### MULATOS MINE

Ownership	100%
Location	Sonora, Mexico
Status	Operating
Operation	Open Pit, heap leach & high grade mill
Commodity	Gold

ANNUAL OPERATING DATA		2013A	2014A	2015A
Production	oz Au	190,000	140,500	140,330
Total Cash Costs <sup>1</sup>	US\$/oz	\$496	\$703	\$869
All-in Sustaining Costs <sup>1</sup>	US\$/oz	\$772	\$1,022	\$1,047
		TONNES (000)	GRADE (g/t Au)	CONTAINED OUNCES
Proven & Probable Reserves		44,713	1.07	1,543,000
Measured & Indicated Resources <sup>2</sup>		77,076	1.14	2,823,000
Inferred Resources		13,336	1.14	489,000

<sup>2</sup>M&I resources exclusive of Reserves

Please see 2015 year end [Reserves and Resources](#) statement for additional detail.

### HIGHLIGHTS

Since the start of production, Mulatos has generated approximately \$350 million in free cash flow.

In 2012, Mulatos produced both its millionth ounce and generated its billionth dollar of revenue since the start of production in 2005.

In 2016, Mulatos is expected to produce between 140,000 and 150,000 ounces of gold with AISC<sup>1</sup> decreasing to \$925 per ounce.

The Company expects a further improvement in costs following the development of the higher grade and lower cost Cerro Pelon and La Yaqui satellite deposits.

Based on year-end 2014 reserves, Mulatos has a seven year mine life remaining.



[Click to enlarge map](#)

#### FEATURED VIDEO:



In 2012, Alamos achieved a significant milestone at Mulatos with the mine producing both its millionth ounce of production and generating its billionth dollar of revenue.

#### OVERVIEW

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The 100% owned Mulatos Mine is a conventional open-pit, heap-leach operation with gold recovered through a carbon-in-column circuit. The project was originally contemplated as a 10,000 tpd operation though through various expansions and productivity improvements over the years, today operates at a throughput rate of 17,500 tpd (including 500 tpd from the gravity mill).

In addition to the existing heap leach operations at the Mulatos Mine, the Company processes high grade ore through a 500 tpd gravity mill. Ore is currently being sourced from the Escondida High-Grade Zone after which high grade ore will be sourced from underground at Escondida and San Carlos.

Based on current proven and probable mineral reserves and current throughput rates, Mulatos has an expected mine life of approximately nine years.

In 2012, the Company achieved a number of milestones including producing its one millionth ounce at Mulatos and generating the billionth dollar of revenue all while realizing record annual financial and operating results with record production of 200,000 oz.



## LOCATION

The Mulatos Mine is located within the Salamandra Concessions in the Sierra Madre Occidental mountain range in the east-central portion of the State of Sonora, Mexico. The mine is approximately 220 kilometres by air east of the City of Hermosillo, and 300 kilometres south of the border between the United States of America and Mexico. The Salamandra Concessions are 100% owned by Alamos and consist of 30,356 hectares of mineral concessions, in 44 discrete concessions. These cover the Mulatos deposit, the satellite gold systems known as Cerro Pelon, La Yaqui, El Realito, El Carricito, El Halcon, Las Carboneras, El Jaspe, Puebla, Los Bajios, and La Dura, and other prospective exploration targets. Mineral rights for all the Salamandra Concessions are controlled by Minas de Oro Nacional, S.A. de C.V., a wholly owned subsidiary of Alamos.



## HISTORY

The Mulatos project was acquired in February 2003 for \$10 million. Following completion of a feasibility study, construction began in the third quarter of 2004. The mine was built at a cost of approximately \$74 million with the first gold pour completed 2005 followed by commercial production on April 1, 2006. The operation was initially contemplated as a 10,000 tpd operation though with future expansion potential in mind, major components of Mulatos including the crusher/conveyor and gold recovery plant were sized for a 15,000 tpd operation. A number of expansions and productivity improvements have taken place through the years with the Company expecting daily crusher throughput to average approximately 17,500 tpd in 2013.

In addition to the existing heap leach operations at the Mulatos Mine, between 2009 and 2012, the Company developed the Escondida high-grade zone at an approximate cost of \$61 million and constructed a 500 tpd mill to process high-grade ore from Escondida at a cost of \$20 million.

## 200,000 OUNCES

In the year-ended December 31, 2012, the Company produced a record 200,000 ounces of gold at a total cash costs<sup>1</sup> of \$438 per ounce.

## MULATOS TECHNICAL REPORT 2012



**Geology**

The Mulatos District occurs within the Sierra Madre Occidental volcanic province. Deposits in the district are hosted within a mid-Tertiary dacitic to rhyodacitic volcanic dome complex and are considered high-sulphidation, epithermal deposits. Gold mineralization is closely associated with silicic and advanced argillic alteration occurring near the upper contact of a rhyodacite porphyry and in overlying dacite flows and volcaniclastic rocks. All lithologic units of the dome complex are intensely altered. Alteration assemblages are typical of high-sulphidation deposits and show zonation patterns from distal propylitic alteration through illite to kaolinite to dickite/pyrophyllite to pervasive, vuggy silica alteration. Gold is predominantly hosted within this silicic alteration. The altered and mineralized units are locally overlain by a thick section of unaltered volcanic rocks that are believed to be post-mineral in nature. Tilting and post-mineral normal faulting associated with late Tertiary extensional (basin and range) tectonics have affected both the mineralized flow dome complex and overlying volcanic rocks. North-northwest and northeast trending faults cut all rocks in the Mulatos area. The Mulatos mine is exposed in the footwall uplift of the Mulatos extension fault.

The Mulatos deposit proper is composed of the contiguous Estrella, El Salto, Mina Vieja, and Puerto del Aire resource areas. The Escondida deposit is the faulted extension of the Mina Vieja and El Salto deposits and mineralization is believed to be continuous to the northeast to the Gap, El Victor and San Carlos mineralized areas. Although zones are often bounded by post-mineral faults, together they form a trend of 2.7 km of gold mineralization starting at the north end of the Estrella pit to the San Carlos deposit.

Within the larger Salamandra Concessions, and generally within 20 km from the Mulatos deposit, geologically similar high-sulphidation gold deposits, occurrences, or prospects are known. The principal ones, some of which are in the process of being evaluated and/or drill-tested, are: Cerro Pelon, La Yaqui, El Realito, El Carricito, El Halcon, Las Carboneras, El Jaspe, Puebla, Los Bajios, and La Dura.

**Mineralization**

Gold deposits of the Mulatos district are high-sulphidation, epithermal, disseminated gold deposits. Precious metal mineralization at Mulatos is associated with intense silicic alteration (mostly vuggy silica), advanced argillic alteration, and the presence of hydrothermal breccias. The original protoliths (dacite porphyry flow/tuff, coarse grained volcaniclastic rocks, breccias), as indicated by surface mapping and core drilling, may have contained in the order of 2-3 percent sulphide as pyrite with various amounts of enargite and tetrahedrite.

Gold mineralization occurs primarily within areas of pervasive silicic alteration of the volcanic host rocks, and to a lesser extent, within advanced argillic alteration assemblages proximal to silicic alteration. The gold-bearing advanced argillic zones are dominated by pyrophyllite or dickite alteration. Silicic rocks host approximately 80 percent of the contained gold within the deposit.

Staudte (2001) describes three main mineralization assemblages. From oldest to youngest they are: 1) quartz + pyrite + pyrophyllite + gold; 2) quartz + pyrite + kaolinite + gold + enargite; 3) kaolinite + barite + gold. Free gold is commonly found in hematite-filled fractures. Gold also occurs in pyrite, as gold/silver telluride minerals, and possibly as a solid solution in some copper sulphide minerals. Supergene oxidation and perhaps remobilization and secondary enrichment of gold have been ongoing since the post-mineral volcanic cover was removed.

Gold mineralisation exists in oxide, mixed oxide/sulphide, and sulphide ore types, with pyrite as the primary sulphide mineral. The deposits are amenable to cyanidation in all ore types, but gold extraction decreases with decreasing levels of oxidation.



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## MINING AND PROCESSING



Mining and processing at Mulatos is via conventional open-pit mining methods followed by a four stage crushing circuit after which it is conveyed and stacked and leached on the heap leach facility. Current throughput rates are budgeted at 17,500 tpd. Gold is ultimately recovered through a carbon-in-column circuit, and an electrowinning and refining plant.

### Mining

Mining at Mulatos is by way of conventional open pit methods with the addition of underground mining operations expected to commence in 2014. The open pit mining is a typical drill, blast, load haul operation with mining in the main pit being done with 9 meter bench heights. The mine switched from a 6 meter to 9 meter bench about two years ago for improved productivity. It is anticipated that a 3 meter bench will be used at Yáqui and Pelon to improve selectivity. The open pit schedule calls for an average of 17,500 tonnes per day. The mill started in early 2012 at 500 tpd which is currently supplied by the open pit mining in the Escondida area of the main pit. This ore will be augmented with underground ore from Escondida Deep and San Carlos.

The primary mining method used to recover high grade underground ore at Escondida Deep and San Carlos will be long hole open stoping (LHOS) with delayed backfill. This will be supplemented by a modified drift and fill method where the thickness of economic mineralization does not permit LHOS.

### Processing

Lower grade from the open pit is processed through four stages of crushing to a target size of 95 percent minus 3/8 inches. Run-of-mine ore is delivered to the primary crusher feed hopper by rear-dump haul trucks. Ore is first crushed to 80%, passing a 15-centimetre screen in the primary jaw crusher. Primary crushed ore is then fed to the secondary cone crusher after which it is conveyed to scalping screens where oversized ore is conveyed to the coarse ore stockpile while undersized ore is discharged and conveyed to the fine ore stockpile.

Ore is withdrawn from the coarse ore stockpile by two variable speed apron feeders and conveyed to three tertiary crushers, each with a dedicated vibrating feeder. The tertiary crushed ore is conveyed to vibrating screen where oversized ore is transferred to and crushed in the single quaternary cone crusher. The quaternary crushed ore is discharged onto the crusher conveyor and recirculated back to the vibrating screen. The undersized screened ore flows to the fine ore collection conveyor, ultimately to the fine ore stockpile. This process has "closed the crushing circuit" such that oversized material is re-circulated through the crushing process and approximately 95% of the ore passes through the 3/8-inch screen to be delivered to the pad. The higher consistency of the crushed product has positively impacted recoveries.

After crushing, lime and cement are added and the ore is conveyed to a pair of agglomerators. Once agglomerated, the ore is delivered to the leach pad for stacking and leaching via a series of portable conveyors ending with a radial stacking conveyor. The heaps are underlain by an impermeable plastic layer on top of a layer of compacted clay.

To extract the gold from the ore, a low-concentration cyanide solution is applied to the ore on the leach pad using a low-pressure irrigation sprinkler system. Alamos installs inter-lift liners on the pad on a periodic basis to reduce percolation time, which decreases the time it takes to extract and produce gold from each lift of the heap.

The resulting gold-bearing solution is channelled to the pregnant solution pond and is then pumped to the carbon-in-column circuit, where gold is recovered from the solution. The barren solution is then recirculated to the heap with added cyanide. Dore bars are produced on site and transferred to a third-party refinery for final recovery of gold and minor amounts of silver.

