

## OROGENIC GOLD DEPOSITS: MEXICO'S ENDOWMENT AND FUTURE DEVELOPMENTS IN THE ALTAR TREND, SONORA <sup>(1)</sup>

<b>Expositor</b>	<b>Día</b>	<b>Hora</b>	<b>Sala</b>
Matt Gray	Miércoles 24	11:00 – 11:30	Sala A

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In the last 10 years orogenic gold deposits have become an important part of the gold endowment of Mexico. In 2017 the total annual production from orogenic deposits in Mexico was 790,000 ounces and 3 of the 11 largest gold mines in Mexico are producing gold from these deposits. Publicly disclosed Proven and Probable Reserves and Measured and Indicated Resources for Mexican orogenic gold deposits sum to 16.4M ounces, approximately equal to the known Reserves and Resources contained in low sulfidation epithermal deposits for which Mexico is more famously known.

Orogenic deposits, also known in the literature as mesothermal and greenstone gold deposits, are associated with regional scale deformation structures and occur in all time periods 2.8 Ga (Archean) and later. They are characterized by Au, As, and S enrichment, are formed by relatively low salinity (<10%) CO<sub>2</sub> enriched fluids, with evidence for P-T deposition conditions of 1- 3 Kbar and 250 – 400° C, implying a 5 – 20 km depth of formation. Deposits are not lithology dependent, and formed at or above the ductile/brittle transition zone. Economic deposits occur as both low grade bulk minable zones and high-grade veins. Vertical continuity of gold grade of 1 to 3 km is common. Mineralogically and metallurgically these are “easy” deposits with native gold, microscopic to megascopic scale, being the common ore mineral.

Areas prospective for the discovery of orogenic deposits in Mexico are found in Sonora, Baja California, and Baja California Sur, but because of political and social reasons, only the Altar Trend of Sonora is recommended for investment of exploration funds. The Altar Trend is the premiere orogenic gold district in Mexico and is the source of nearly all current production from orogenic deposits in Mexico. The trend is defined by known occurrences of orogenic gold mineralization, and measures over 200km long and 70km wide, extending from the Soldedad-Dipolos mine in northwest Sonora southeastward to beyond the San Francisco mine in north central Sonora (Figure 1). Since 1997, the Altar Trend has produced 9M ounces of gold, and 2018 production is estimated to be 900,000 ounces. Publicly disclosed Proven and Probable Reserves and Measured and Indicated Resources for the Altar Trend sum to 13.3 M ounces. Notable gold producers in the Altar Trend include: the

La Herradura (Centauro deposit) and Noche Buena mines of Fresnillo PLC, the San Francisco mine of Alio Gold, and the El Chanate mine of Alamos Gold (Figure 1). Host rocks include Precambrian gneisses (La Herradura), greenschists and amphibolites (San Francisco), Jurassic rhyolitic volcanics and volcanoclastic strata (Noche Buena), Cretaceous clastic and calcareous sedimentary strata (El Chanate) and Tertiary granites (San Francisco). Orogenic deposits in the Altar Trend formed during the period 69 to 36 Ma with orogenic deposit formation peaking around 61 Ma (Izaguirre et al., 2017). The orogenic deposits of the Altar Trend are roughly coeval with the formation of the porphyry copper deposits found further east, and both are related to volcanic arc migration during the Laramide orogeny. The orogenic deposits of the Altar Trend are spatially associated with the hypothesized Mojave Sonora Megashield (Andersen et al., 2005) but a genetic relationship between the two is unproven (Figure 1).

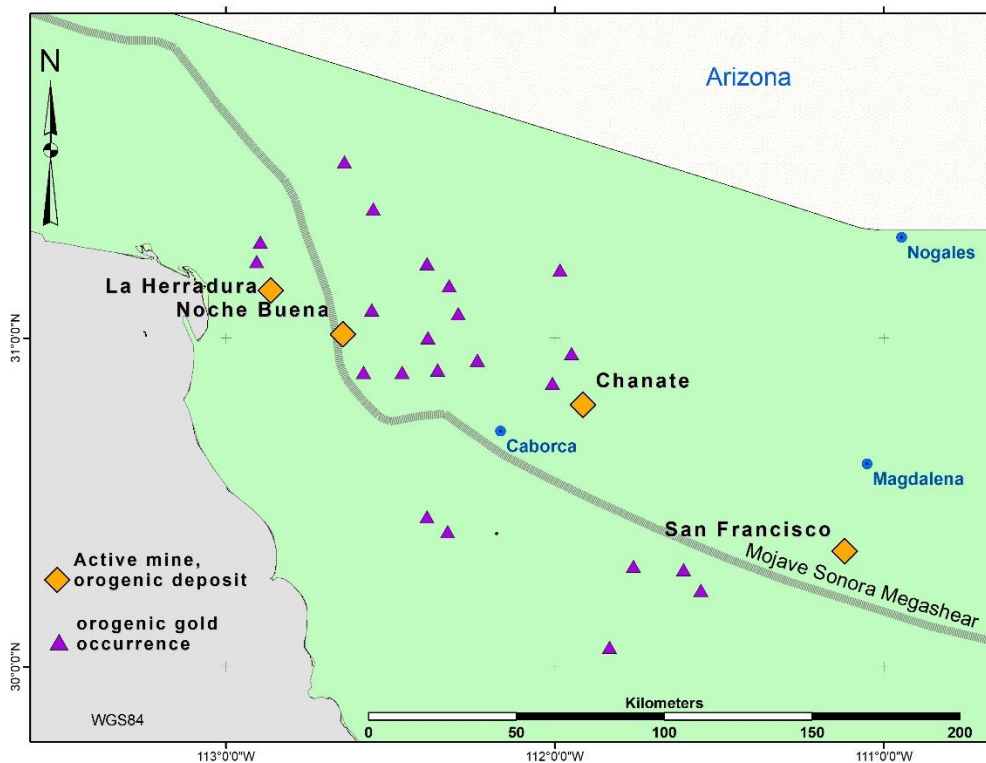


Figure 1. Major mines of the Altar Trend.

Most production from the Altar Trend has been from large scale, relatively low grade open pit mines, however future production from the region is likely to become increasingly dependent on higher grade, underground mines. Because of geologic characteristics specific to orogenic gold deposits, they should be a preferred target for exploration in Mexico. The most prospective geologic terrain, the Altar Trend, coincides with a favorable logistical/social/political location. The terrain is dominantly covered by colluvial deposits and post mineral cover rocks, thus indirect targeting methods and extensive drill testing is required to discover new, non-outcropping deposits. The terrain is highly prospective for discovery of both large-scale bulk minable deposits and high-grade deposits amenable to exploitation by underground

mining. Orogenic deposits, due to their kilometer scale vertical extent, present opportunities to develop high grade, long life underground mines. The relatively small footprint of an underground mine may facilitate obtaining social license to operate and favors development. Exploration drilling conclusively proves that high grade orogenic vein deposits occur within the Altar Trend, and some may be amenable to underground mining. Drilling by Fresnillo PLC at the La Herradura mine complex has demonstrated that gold mineralization continues over a vertical interval of at least 1500 meters and Fresnillo is drill defining a resource at the Centauro Deep zone beneath the Centauro Pit. This zone contains a currently reported Measured and Indicated Resource of 4.7Mt @ 3.9 gpt Au (581,000 ounces) and Fresnillo PLC is evaluating the feasibility of underground mining Centauro Deep. Exploration for deep, high grade targets in the Altar Trend is in its infancy, but given that the Mexican mining industry has particular expertise with underground mining of vein deposits, it seems likely it is a question of when, not if, headframes will be coming to the Altar Trend.

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