CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
520-770-3500
http://www.azgs.az.gov
inquiries@azgs.az.gov

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GEOLOGY AND MINERALIZATION OF THE FORTUNA AND TUMCO MINES: PERALUMINOUS GOLD DEPOSITS, SOUTHERN ARIZONA AND CALIFORNIA

James D. Gill

G. M. Smith

C. M. Graubard

MagmaChem Exploration, Incorporated
Boulder, Colorado

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Abstract. Several significant past and present producers of high grade and bulk tonnage gold ore from southeastern California and southwestern Arizona can be empirically and genetically linked to regional peraluminous magmatism which occurred during the late Cretaceous and early Tertiary. Geological relationships and geochemical characteristics from the Fortuna Mine area will be described and compared to those of the Tumco Mines area. Each of these historical gold producers is viewed as a morphologic end member in otherwise genetically linked metallogeny. Gold-quartz veins at Fortuna can be directly linked to peraluminous pegmatites both physically and mineralogically. Silica-magnetite±epidote±garnet rock which occurs as relatively barren, discontinuous, foliation-parallel horizons at Fortuna, but as high grade gold ore at Tumco, is interpreted as replacement of calcareous units during the same episode of peraluminous magmatism responsible for the gold vein mineralization. Whole rock and trace element data from pegmatites and aplites of the Fortuna and Tumco areas, together with data from the Gunnery Range batholith of southwestern Arizona, indicate that the magma series (after Keith, 1984) responsible for the gold metallogeny is peraluminous calcic, and is quite rich in sodium.

Fortuna Mine

Geology and Production History

The Fortuna Mine is located on the west flank of the Gila Range, approximately 12 km south of highway 8, in the southwestern corner of Arizona (Figures 1 and 2). Between 1896 and 1904 about 3,826.7 kg of gold and about 316.6 kg of silver were recovered from approximately 131,500 metric tons of rock (Wilson, 1933). Subsequent production increased the total recovered gold to approximately 4,074.6 kg and silver to approximately 451 kg from an additional 7,257.5 metric tons (Keith, et.al., 1983) for an overall grade of 29.4 g/metric tons gold and a Au:Ag ratio of 9:1.

Essentially all gold was produced from a quartz vein system striking S40W and dipping 70SE, the surface expression of which has been almost entirely mined out (Wilson, 1933). The system consisted of two veins, several feet apart at the surface: the main vein was 6.1 m long and a maximum of 3.7 m wide and the footwall vein was 9.1 m long and a maximum of 1.5 m wide. The two veins joined at about the 152 m level in a body less than 30.5 m long and formed a single continuous vein to the 244 m level where it was between 0.5 and 3.7 m wide. The vein was faulted out at the 244 m level and only a small segment was found below (Wilson, 1933).

The Fortuna vein crosscuts a series of greenschist to amphibolite grade supracrustal rocks. Host lithologies are dominated by metavolcanic amphibolites with lesser metaclastic and metacarbonate rocks. Numerous garnet±muscovite and biotite bearing, peraluminous granitic pegmatites intrude the area and in places can be seen to be intimately associated with gold bearing quartz veins in the area surrounding the Fortuna Mine (Figure 2). The peraluminous pegmatites exposed in the immediate vicinity of the Fortuna Mine and the larger peraluminous masses seen in nearby exposures are related to the regionally extensive Gunnery Range batholith (Figure 1).

Massive to banded rocks composed of silica-magnetite±garnet±epidote are locally present at Fortuna and are generally concordant to the layering in the metamorphic country rocks (Figure 2). These units are discontinuous along strike and occur both as 0.3 to 1.2 m thick horizons and as thin, irregular streaks in the gneisses with outcrop scale preservation of replacement textures. This rock type is lithologically similar to silica-magnetite rock exposed 55 km to the northwest at the Tumco and American Girl Mines of the Cargo Muchacho Mountains. At Fortuna this lithology contains only traces of gold while the similar unit in the Tumco valley constitutes high grade gold ore.

Mineralization, Alteration and Geochemistry

The Fortuna veins consisted of quartz, free gold, traces of malachite and intergranular specular hematite. Small brown garnets, magnetite and feldspar have been reported from the main vein system (Wilson, 1933), and have been observed in smaller quartz veins throughout the area, supporting the suggested link with peraluminous igneous activity.

Wall rock alteration surrounding veins at Fortuna consists of brown calcite and silicification (Wilson, 1933). Some of the Fortuna pegmatites are associated with fringing aluminous alteration of surrounding country rocks.

Production data (Wilson, 1933 and Keith, et.al., 1983) shows that the Fortuna system was very gold rich with a Au:Ag ratio of 12:1. Mineralized material is presently very difficult to sample. Of the samples taken, base metal content is extremely low, with Cu/Cu + Pb + Zn relatively high; arsenic and antimony are both quite low.

Interpretation

The gold-quartz vein mineralization at Fortuna is interpreted as fluid concentrated by final crystallization and differentiation of peraluminous calcic granitic rocks. The silica- magnetite-calcsilicate bodies are interpreted as replacements related to the same igneous event. At Fortuna these replacement bodies are almost barren, whereas at Tumco they constitute gold ore. The peraluminous igneous event responsible for the gold metallogeny was regionally extensive in the southwest U.S. and northern Sonora, Mexico and is locally represented by the Gunnery Range batholith which is late Cretaceous to early Tertiary in age.