LateMiocene high sulfidation epithermal gold deposits of the Aruntani district, southern Peru

Late Miocene high-sulfidation epithermal gold deposits of the Aruntani district, southern Peru: Recent discovery of a new ore type in an abandoned mining district

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Introduction

Exploration since 1997 discovered potential for multi million ounce (oz) gold mineralization in a historic silver – base metal mining district of southern Peru, the latter including the abandoned Pavico and Caccachara mines, ~100 km south of Puno (fig. 1). These are the first significant epithermal gold deposits recognized in the Western Cordillera of southern Peru, ~100 km from the border with Chile, and this is the first report of the discoveries of these high-sulfidation deposits.

The vein mineralization at Pavico and Caccachara was mined since the 18th century for silver, and during the 20th century for silver and base metals. Exploration programs carried out by several national and international companies during 1991 to 1996 were not successful.

The Santa Rosa deposit was discovered by MDH geologists in 1997, followed by the discovery of the Tucari deposit in late 2000 (fig. 2). The former has produced 150,000 oz gold since 2002, and the latter, larger deposit is in the initial stage of mining. Total production for 2004 is projected at 200,000 oz gold. Ongoing exploration in the Aruntani district is focused on three newly defined target areas (fig. 3).

Regional geology

The district is hosted by the Late Miocene Barroso Formation, a regionally extensive magmatic province in southern Peru (fig. 2). In the Aruntani district, atypical magmatism includes rhyolitic dome complexes first recognized during this exploration, as well as typical andesitic stratovolcanoes erupted at ~7 to 6 Ma. This volcanism followed at least 10 myr of volcanic quiescence, beginning soon after cessation of a major compressive deformation phase. Early generation of thick and widespread dacitic to rhyolitic pyroclastic deposits was followed by the emplacement of a major rhyolitic dome complex. The main phase of voluminous andesitic volcanism was concluded by late stage dacitic intrusions.

Local geology and alteration of the deposits

The northwest-striking mining district is over 700 km^2 in area, as defined by hydrothermally altered volcanic rocks which are clearly identifiable on LANDSAT and ASTER imagery (fig. 3). There are at least five major hydrothermal centers, of which at least two host ore deposits, Santa Rosa and Tucari. The location of the deposits is controlled by intersections of principal north to north-west, and east-west striking faults.

Mineralization is hosted by felsic lava domes and late-stage dacitic intrusions in trachyandesitic flows that show a characteristic alteration pattern, from a core of massive silicic and vuggy quartz, some with granular texture, outward to quartz-alunite. Sulfides include pyrite and enargite which have been largely oxidized within 300 to 450 m of the surface in the silicic zones.

Figure 1. Location of the Aruntani mining district, hosting the first major epithermal high-sulfidation gold deposits in the southernmost part of the Peruvian Miocene volcanic belt.

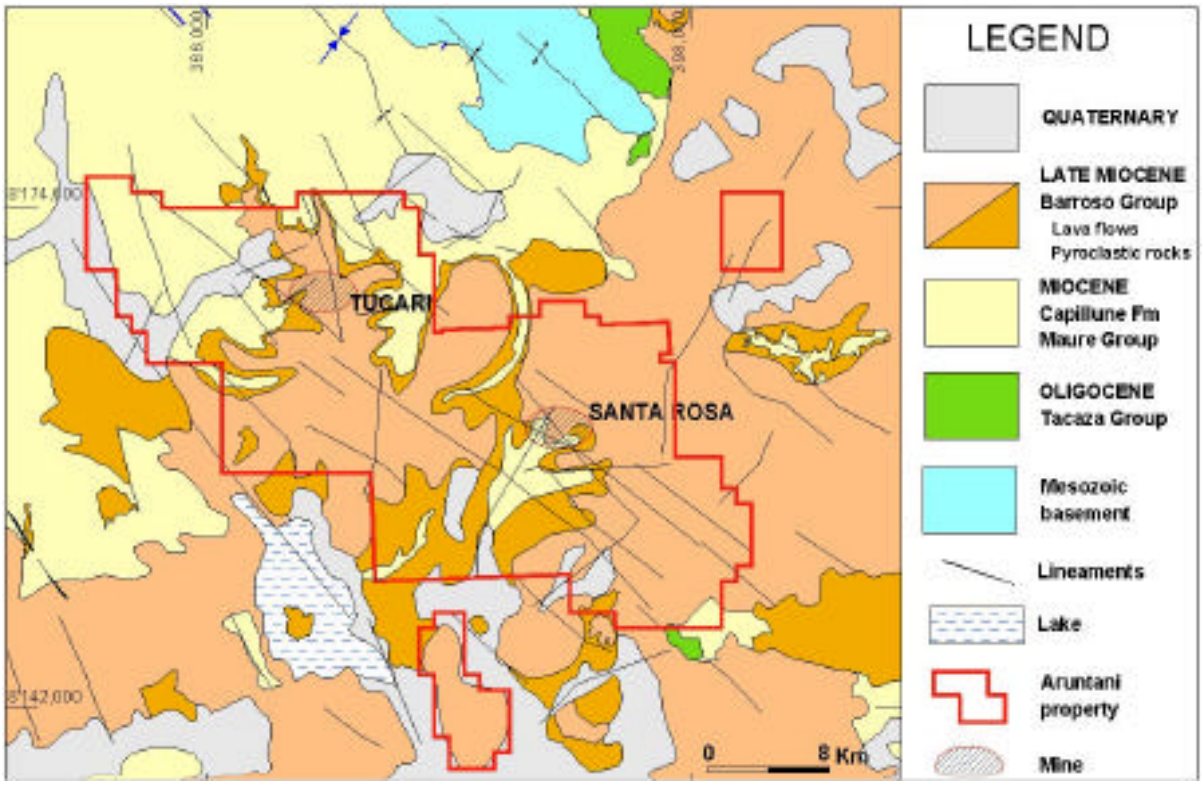


Figure 2. Regional geological setting of the Aruntani district, modified after INGEMMET.

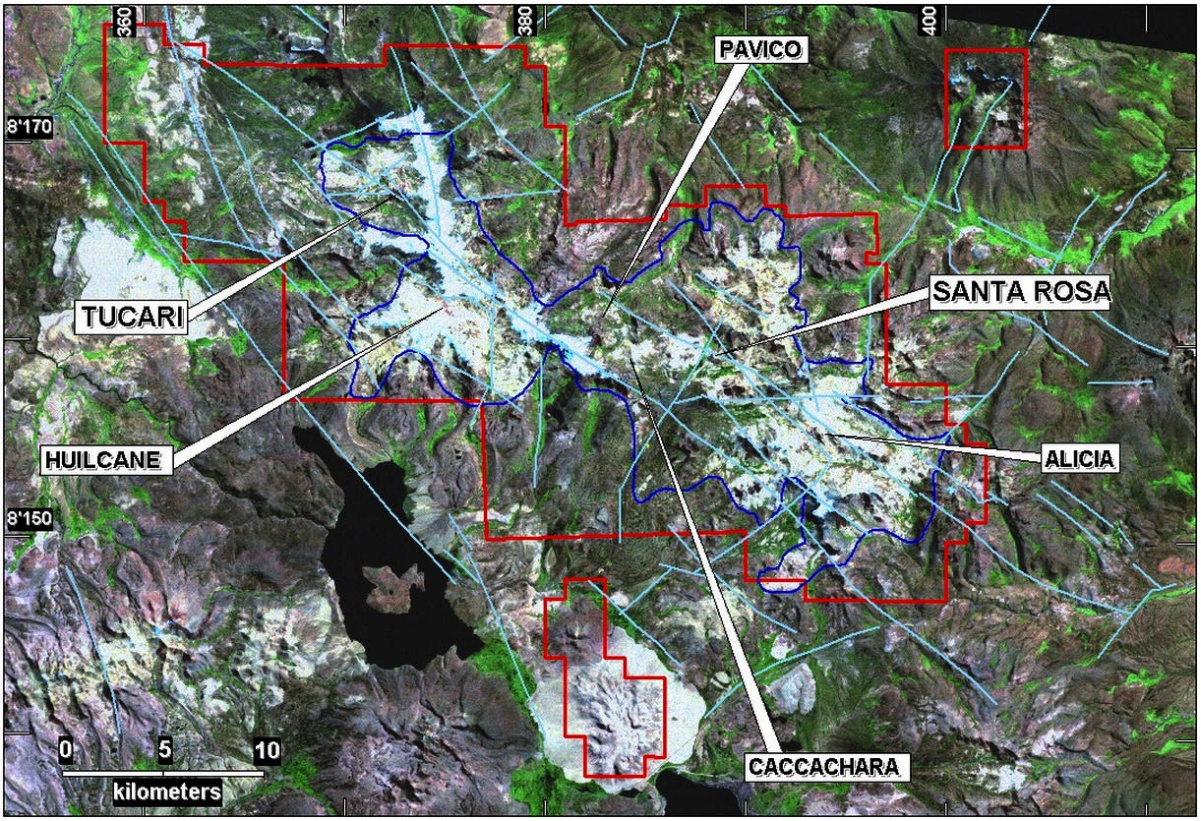


Figure 3. Landsat TM image: Outline of alteration (dark blue), principal structures (light blue) and principal centers of mineralization within the Aruntani district. The old silver-base metal mines Pavico and Caccachara are shown.

Specific characteristics of the deposits

Santa Rosa and Tucari are typical high-sulfidation epithermal deposits, with characteristics similar to other such Peruvian deposits, e.g., Yanacocha, albeit not yet as large (fig. 1). At Santa Rosa gold is related to the margin of a rhyolitic dome and associated tuff sequences and is hosted dominantly by silicic altered tuffs, tuff breccias and related volcanic rocks that form the core of the deposit. Gold appears to have been introduced during events associated with crackle brecciation, with ore also influenced by permeability associated with vuggy quartz development and zones of hydrothermal breccias. The Santa Rosa deposit shows clear structural control of high-grade ore zones, e.g. the NNW striking Cotañani fault, and lithological control on ore horizons (figs. 4 and 5). Sulfides in the ore zones are largely oxidized.

Reserves at Santa Rosa are now 5 million tons, containing 1.53 g/t, for a total of 252,000 oz gold.

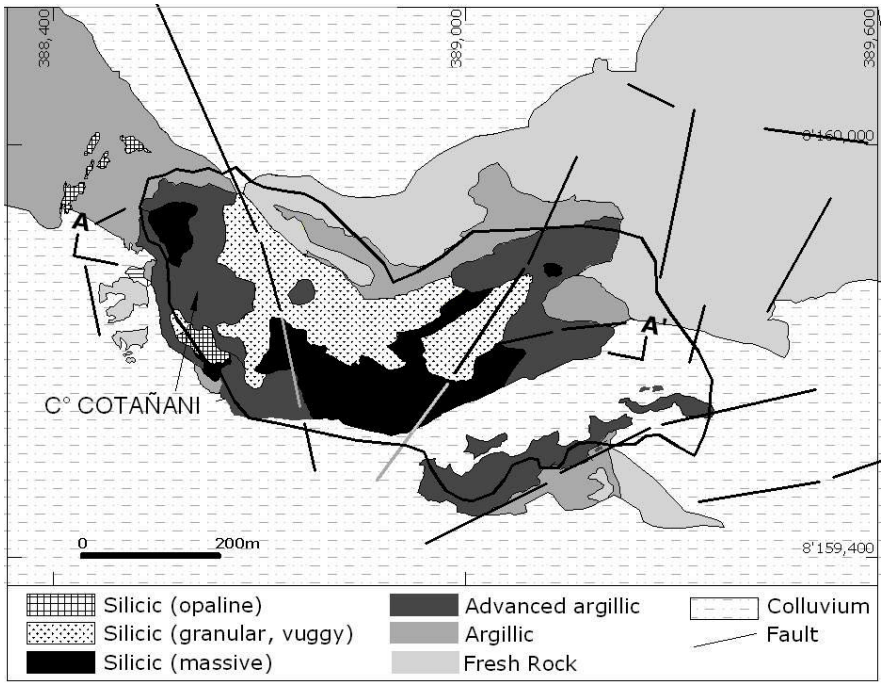


Figure 4. Santa Rosa deposit, plan map: Types of alteration, and outline of final pit design.

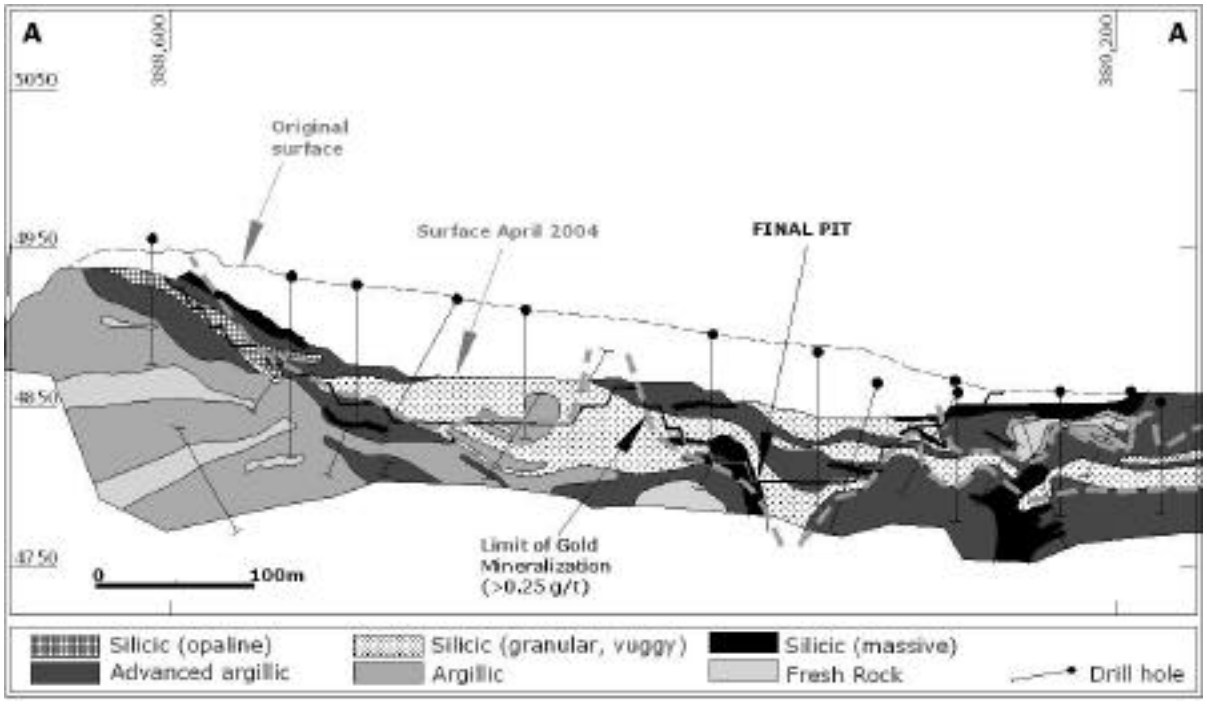


Figure 5. Santa Rosa open pit, long section: Types of alteration and outline of > 0.25 g/t gold..

The Cerro Tucari deposit, 20 km WNW of Santa Rosa, has been defined within a 1200 m long by 450 m wide and 400 m deep body. Alteration is related to the emplacement of late stage dacitic intrusions into the central part of a complex andesitic stratovolcano. Multiple stage hydrothermal breccias are the centers of extensive massive silicic to granular silica alteration, mantled by advanced argillic to argillic alteration zones. The breccias and related mineralization are mainly controlled by NNW and E-W striking faults and joints.

Colluvial scree on the south steep face of Cerro Tucari reported an average of 2 g/t Au, not only indicating the grade on the face but also providing an initial body of broken rock containing 150,000 oz gold. Resources at Tucari are about 50 millions tons containing 1.0 g/t, for a total of 1,600,000 oz gold.

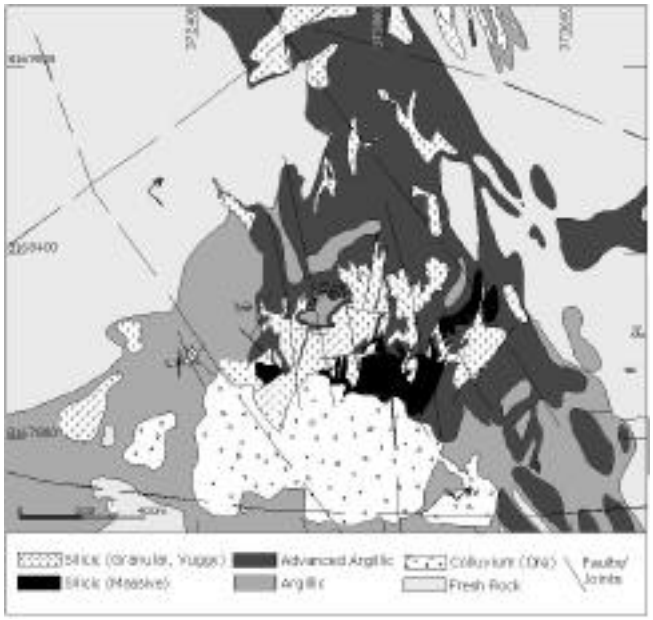
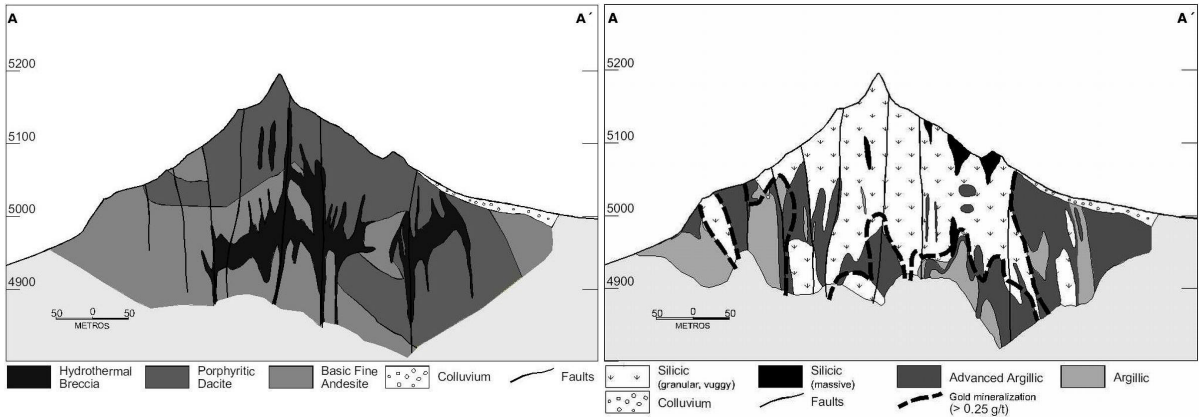


Figure 6. Tucari deposit, plan map: Types of alteration and principal structures.



Figures 7a, b. Tucari deposit, cross sections NW-SE: Geology and types of alteration based on drill holes.

Discussion

There is evidence in this district for longevity of the magmatic systems, like repeated episodes of felsic volcanism, possibly one factor that led to the generation of economic deposits. The spatial association of gold mineralization to felsic intrusions in southern Peru has not been previously documented. Such an association with shallow-level magmatism constitutes a new exploration target in the region.

The presence of other systems in the district such as Alicia and Huilcane (fig. 3) provides further potential, some lying beneath zones of steam-heated alteration, as well as young but relatively thin volcanic cover. This potential includes both large tonnage high-sulfidation oxidized gold deposits as well as smaller but higher grade intermediate sulfidation quartz-carbonate veins.

Acknowledgements

Continuous support of the recent investigations by Mr. Guido Del Castillo, including his permission to publish these preliminary results is highly appreciated.