Summitville Mine, Colorado

Geology
Contamination
and Clean-up

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“Large, low to medium grade deposits in which hypogene sulfides are primarily structurally controlled and which are spatially related to felsic or intermediate porphyritic intrusions.”
from Park & Guilbert, 1986, The Geology of Ore Deposits
San Manuel-Kalamzoo Deposit

Fig. 1. Schematic drawing of structural history of San Manuel-Kalamzoo deposit. (a) at time of emplacement and (b) at present. Note the umbrella-like flare of dike swarm and the chalcopyrite enrichment zone (CC6). pCqm = porcellane Granite, TKmp = monzonite porphyry, Tcb = Cloudburst Formation, Tgc = Gila Conglomerate.
San Manuel-Kalamzoo Deposit – Alteration Zones

Legend
- **adul** = adularia
- **Ag** = silver
- **alb** = albite
- **anh** = anhydrite
- **Au** = gold
- **bi** = biotite
- **carb** = carbonate
- **chl** = chlorite
- **cp** = chalcopyrite
- **epi** = epidote
- **gai** = galena
- **kaol** = kaolinite
- **K-feld** = K-feldspar
- **mag** = magnetite
- **mb** = molybdenite
- **py** = pyrite
- **q** = quartz
- **ser** = sericite
- **sl** = sphalerite

Approximate 1 km

0 3000 ft
San Manuel-Kalamzoo Deposit – Alteration Zones
The Summitville Gold Deposit is related to, but different from a classic porphyry Cu/Mo deposit
Tertiary Volcanism in the San Juan Volcanic Field

- B – Bachelor
- BZ - Bonanza
- C – Creede
- CP – Cochetopa Park
- H – Mount Hope
- L – Lost Lake
- LC – Lake City
- LG – La Garita
- PL – Platoro
- S – Silverton
- SJ – San Juan (photos)
- SL – San Luis
- SV – Summitville*
- U – Ute Creek
Ash flows from San Juan Caldera
Hydrothermal Alteration
near the contact with country rocks
Red Mountain
Red Mountain
AMD near Ouray, Colorado
Summitville Geologic Map

- Platoro Caldera formed 30-29 Ma
- Summitville Caldera formed 30-28 Ma
- Quartz Latite dome extruded 22±1 Ma
Ore Deposit is located in South Mountain Quartz Latite Dome

- Platoro Caldera formed 30-29 Ma
- Summitville Caldera formed 30-28 Ma
- South Mountain Quartz Latite dome extruded 22±1 Ma
Acid sulfate alteration was an important precursor stage that provided open-space porosity for subsequent Cu sulfide and gold deposition, diagram from Plumlee, et al., 1995
Along individual fractures, acid sulfate altered rock consists of a vuggy silica zone, followed laterally outward into quartz-alunite, quartz-kaolinite, argillic and propylitic zones; Gray & Coolbaugh, 1994.

**Alunite** = $\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6$

Au is highest in vuggy silica zone
Web Resources

- USGS - Summitville Open File Report
- U.S. EPA - Summitville Superfund Site
  - http://www.epa.gov/region8/superfund/sites/co/sville.html
- (photos included in this presentation)
Figure 2. Oblique aerial photograph, looking south-southwest, of the Summitville Mine and vicinity. The mine is located just east of the continental divide at an elevation of 3800 meters (11,500 ft). Total yearly snowfall is approximately 7–11 meters (20-35 ft). Photo by IntraSearch, Inc.
History of the Mine

- Gold was discovered in 1870
- 1984 – 1992 Summitville Consolidated Mining Company operated a low-grade, high-tonnage, open-pit mine
  - They mined approx. 9,250,000 tons of ore
  - Ore averaged 1.6 ppm Au (0.047 oz/ton)
  - 1986-1992 they extracted 9,400 kg Au (302,000 oz.)
  - Worth about $120 million (at $350/oz. in 1994)
- Mine closed in 1992
- Summitville was put on Superfund National Priorities List in 1994
Ore Processing

- Cyanide Heap Leach System
- Na-cyanide solution is sprayed on crushed ore to dissolve the gold
- Leachate is collected and treated to precipitate the gold
- In 1992, water in the heap-leach nearly overflowed, causing panic in the region
Figure 1. Map of the southeastern Summitville area and adjacent San Luis Valley, SW Colorado.
Acidic metal-rich puddles in the Summitville open pit

formed by dissolved secondary salts in rainwater
Heap Leach Pad – pre-reclamation
View of the Summitville mine site (summer 1998). The mine pit is out of the picture to the right, the reclaimed heap leach pad is in the center left of the photo. The waste pond is out of the photo to the right.
Shown at left is a view of the heap leach pad in the process of being capped. Top soil is laid over the synthetic cap in preparation for seeding in the fall of 1998 and summer of 1999.
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Waste Pond and Water Treatment Plant
Storage Pond/Treatment Plant - 1998

View of the storage pond showing acid and metal-laden water from the mine site. This untreated water goes to the water treatment plant (upper right of photo). At the treatment plant, water is neutralized and toxic metals are removed before release to the creek.
Web Resources

• USGS - Summitville Open File Report
  • http://greenwood.cr.usgs.gov/pub/open-file-reports/ofr-95-0023/summit.htm
• U.S. EPA - Summitville Superfund Site
  • http://www.epa.gov/region8/superfund/sites/co/sville.html
  • (photos included in this presentation)