BIOGEOCHEMISTRY
Discovery Using Metal Concentrations in Plants

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Rosebud Mine

The Rosebud Mine ceased underground mining in 2001. It is located in the Kamma Mountains near Rosebud Peak, Pershing County, Nevada, and about 10 Km southwest of the Sulphur Mining District.

Jurassic-Triassic metasediments of the Auld Lang Syne Group (Jtra), composed of carbonaceous shales, siltstones, sandstones and limestones, form the basement for overlying Tertiary volcanics composed of ash flow tuffs, andesitic flows, interbedded trachyte flows and pyroclastics, rhyolite flows, volcaniclastics, and debris flows. laharic breccia, and epiclastic sediments.

Approximately 65% of the production came from the Tertiary LBT unit (Tlbt), which is a fine grained waterlain & airfall tuff, lithic ash flow tuff, tuff breccia, and massive, very fined grained vitorphyre. Another 35% of the production came from the Tertiary Dozer Tuff unit (Tdt), composed of aphanitic, fine-grained, siliceous, weakly flow-laminated ash-flow tuff, and locally autobrecciated. Mineralization was localized along the South Ridge Fault, which has a dip of about 25^0 and is listric at depth. It has been characterized by some geologists as part of a “flower structure”, or strike-slip duplex (K. Tullar, pers. comm.).

Ore was mined from the 4800 ft level to the 4400 ft level in terrain that has an average elevation of 5400 ft (Figure 11). No ore is found any closer than 200 feet from the surface, and over Dozer Hill, depth to ore is about 1200 feet. Overlying lithologies include barren host LBT unit, barren Tertiary Bud Tuff unit (Tbt), barren Tertiary Chocolate Tuff unit (Tct), and a thin veneer of Quaternary alluvium.

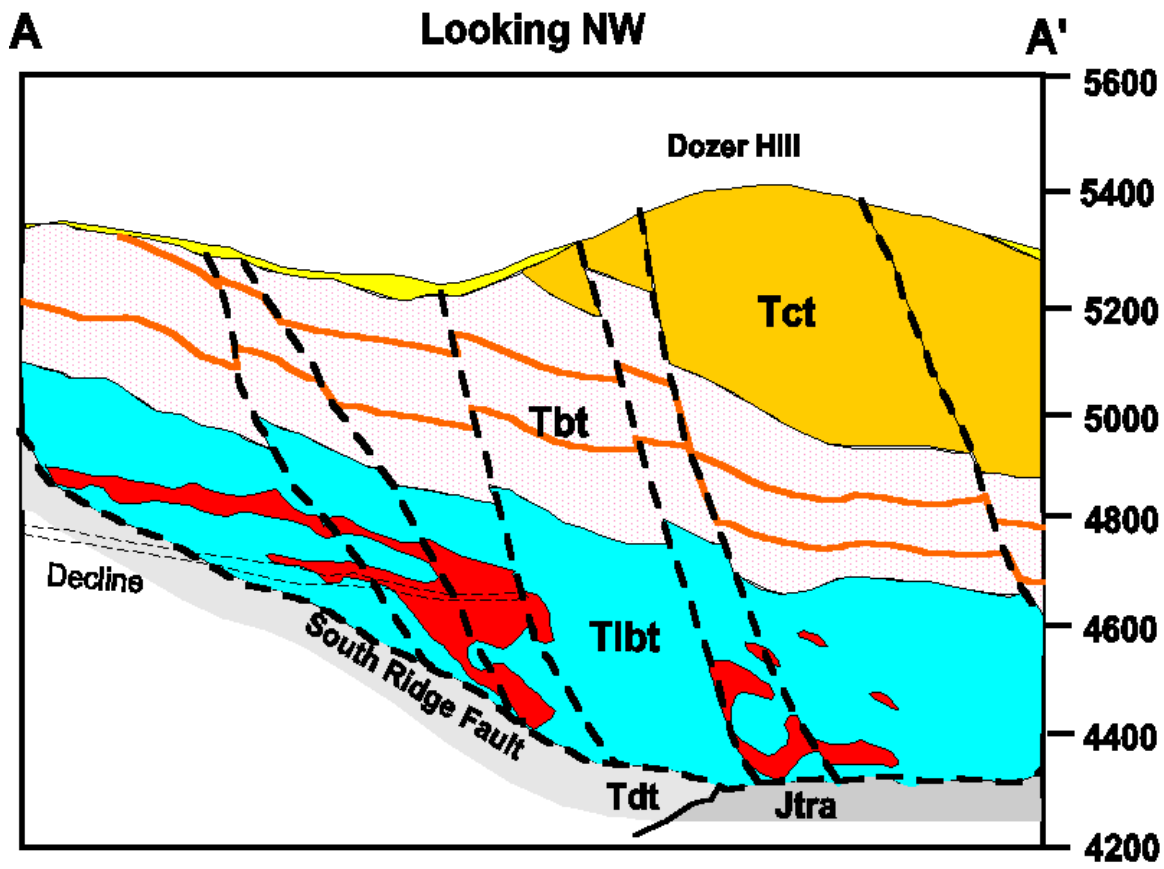

Figure 11. Section through host rock geology at the Rosebud Mine, Pershing County, Nevada. Elevations in feet. Ore above 0.15 opst in red.

Several dip-slip structures as part of the strike-slip duplex “flower structure” intersect the deeper reaches of the South Ridge Fault, and undoubtedly provided conduits for upwardly migrating vadose water.

Sagebrush (A. tridentata and A. abruscula), with minor greasewood, vegetate the area that was biogeochemically surveyed in 1989 under the auspices of LAC Minerals. The survey covered what was later defined as the South Ore Body, which projects to the southwest of Dozer Hill. The North Ore Body lies under Dozer Hill, with extensions to the southwest (East Ore Body). Figures 12-16 show the 0.05 opst gold footprint projected to surface, and the location of the 1989 survey grid.

The biogeochemical survey was preceded by soil surveys, various geophysical surveys (including VLF) and exploratory drilling with the expectation that biogeochemistry would corroborate the earlier work and perhaps add another dimension to what was understood about the prospect at the time. Because other mineral trends and deep ore locations were indicated by the biogeochemistry (which did not have unanimous support from the other survey data), the biogeochemical results were not factored into the ongoing drill program. LAC subsequently sold the property to Equinox, who sold it to Hecla, who sold it to Newmont. It was not until Hecla began mining the property that the relationships between the biogeochemical patterns and deep ore made more sense.

Figures 12-16 show the concentrations of Au, Ag, As, Sb, and Se in sagebrush taken during the 1989 biogeochemical survey. This is superimposed over the footprint of 0.05 opst gold grade. The grade cutoff for mining was 0.15-0.2 opst. The Au plot shows leakage up some of the “flower structures”, revealing pervasive northeast regional trends. Mineralized sections of the South Ridge Fault are identified in the south part of the grid, but a more complete trace of the silicified fault scarp is presented in the As plot. Antimony is co-spatial with Ag, revealing other faults and zones of variable Ag enrichment in the deposit. Finally, it is Se that offers the best match of anomalous concentrations in sagebrush to the footprint of the ore. High Tl and Hg concentrations halo outside the ore footprint, and Ga (like Se) anomalies lie inside the footprint. The Au-Ag-As-Sb-Hg-Ga suite with either or both Te and Se is very common and typical of hydrothermal deposits. Selenium is also associated with high grade bonanza ores, like those currently being mined at the Ken Snyder Mine at Midas, Nevada.

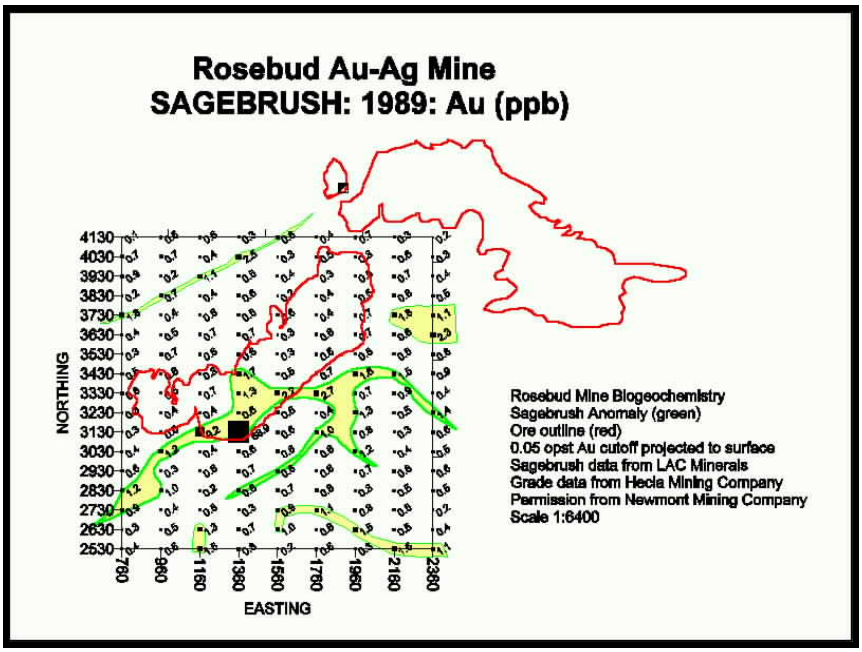

Figure 12. Au concentrations (ppb) in sagebrush over the South Ore Body at the Rosebud Mine, Pershing County, Nevada. Red outline is the 0.05 opst cutoff.

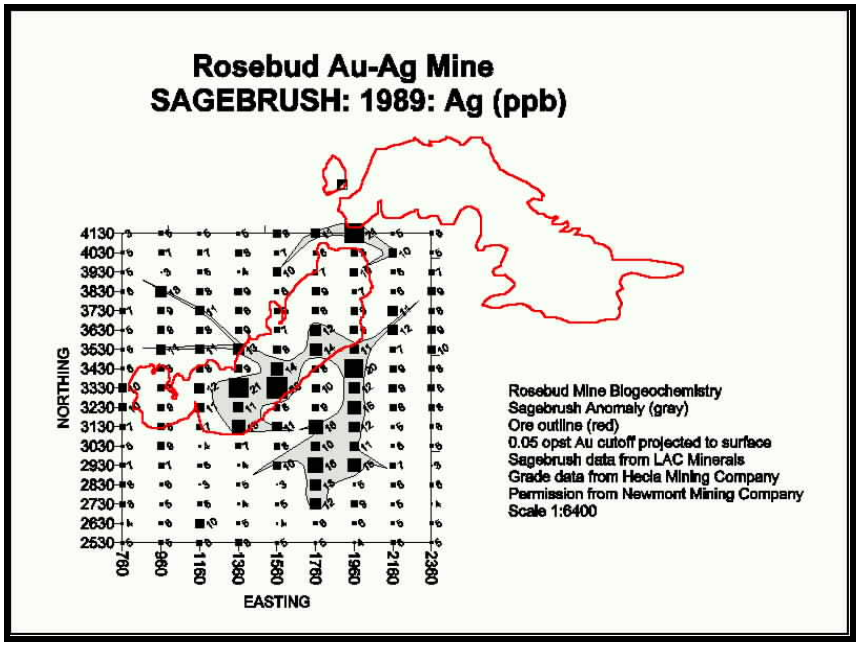

Figure 13. Ag concentrations (ppb) in sagebrush over the South Ore Body at the Rosebud Mine, Pershing County, Nevada. Red outline is the 0.05 opst cutoff.

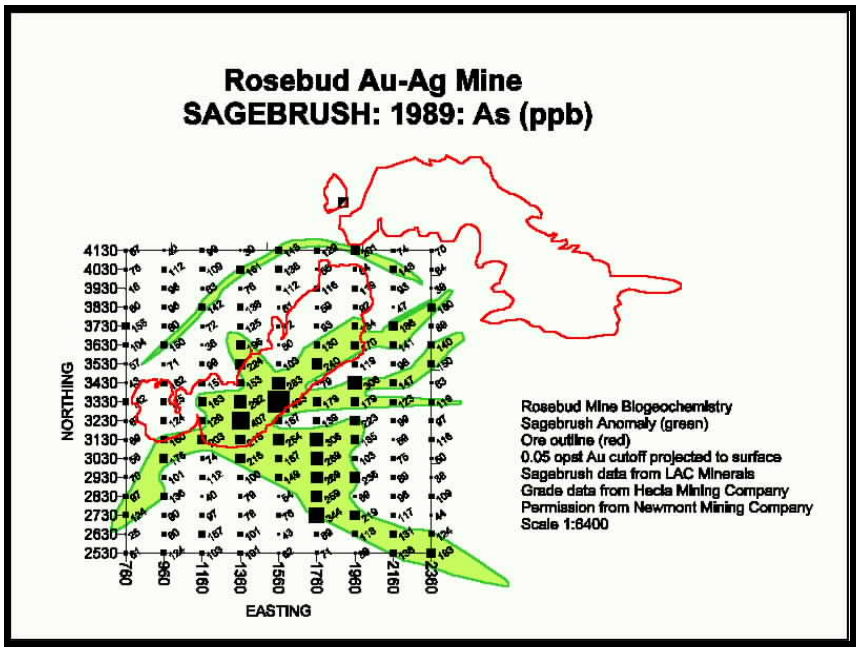

Figure 14. As concentrations (ppb) in sagebrush over the South Ore Body at the Rosebud Mine, Pershing County, Nevada. Red outline is the 0.05 opst cutoff.

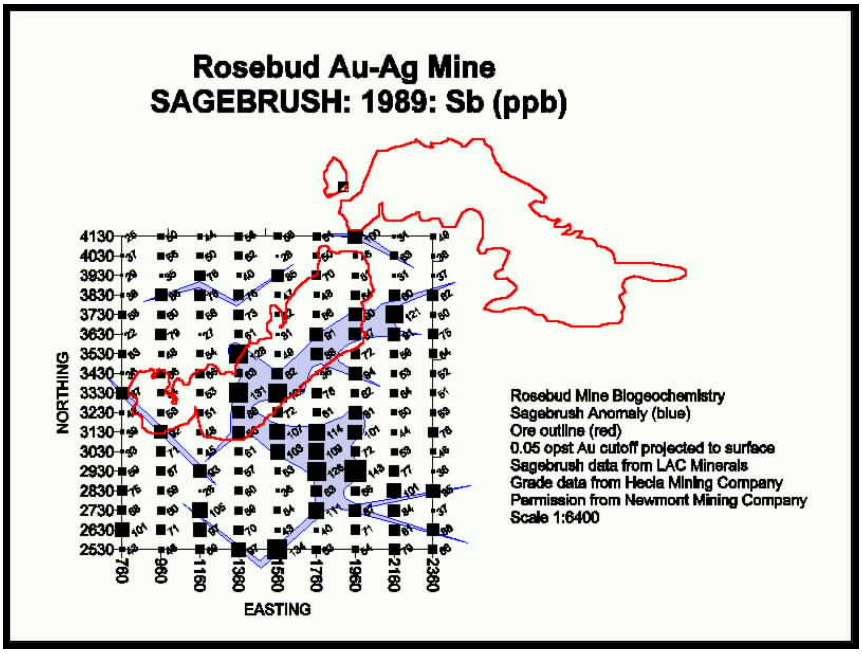

Figure 15. Sb concentrations (ppb) in sagebrush over the South Ore Body at the Rosebud Mine, Pershing County, Nevada. Red outline is the 0.05 opst cutoff.

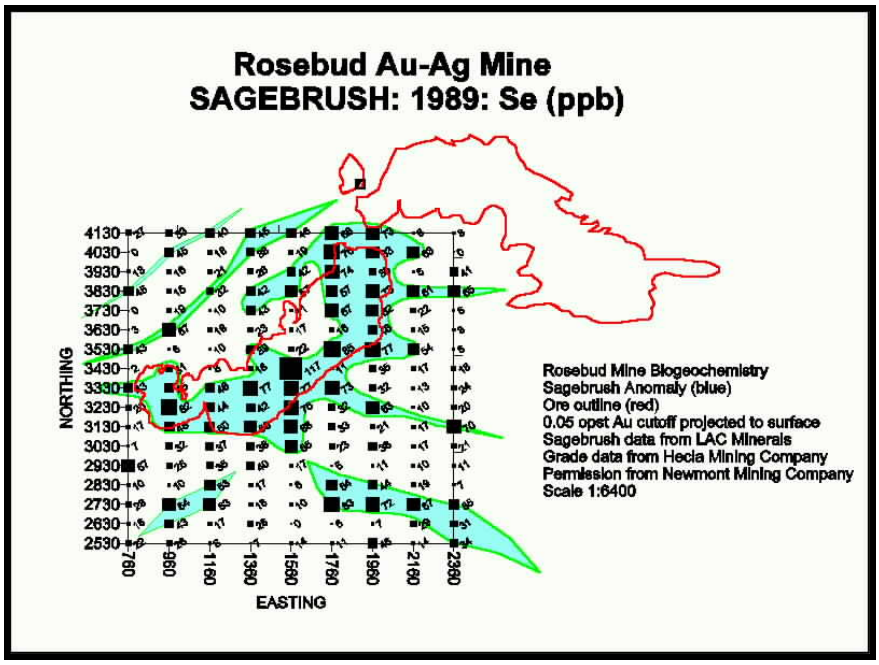

Figure 16. Se concentrations (ppb) in sagebrush over the South Ore Body at the Rosebud Mine, Pershing County, Nevada. Red outline is the 0.05 opst cutoff.

An important consideration, and one that should never be overlooked since ground water / rock interaction is the source of ions that ultimately reflect bedrock chemistry in shrub tissues, is the depth to ground water and areas with maximum ore/ ground water contact. At Rosebud, ground water elevations from an EIS study were reported at 5120-5130 feet at Dozer Hill. Since Dozer Hill is at an elevation of 5300-5400 feet, so the depth to ground water is 270-180 feet. This suggests that the entire ore body was actively being oxidized, and that the release of ions from anywhere in the body would contribute to a surface expression in the vegetation. Other examples in this report show that ore above ground water does not create a source of ions comparable to areas where ore is in ground water. Consequently, it is only those sagebrush in areas with maximum ground water / ore contact that show high metal concentrations (see the Pinson example).