# BIOGEOCHEMISTRY
# Discovery Using Metal Concentrations in Plants

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## Pinson Mine

The Pinson Mine is 61 Km northeast of Winnemucca in north-central Nevada on the east flank of the Osgood Mountains. It is part of the Getchell Trend which includes Chimney Creek & Rabbit Creek (now Twin Creeks), Getchell, Preble, Lone Tree, and the Marigold mines. The CX and Mag ore bodies are hosted in carbonate rocks of the Ordovician age Comus Formation which includes thinly bedded shales and siltstones, thick beds of chert, and dolomite conglomerate. The entire sequence of sedimentary rocks lies within a contact metamorphic aureole of a granodiorite intrusive. The CX deposit is confined to a silicified low-angle east-dipping shear zone. The Mag ore is stongly oxidized to a depth of 60 m below the alluvium / bedrock contact. Fresh sulfides are found at depths of 90 to 120 m. Ground water depths range from 65 to 105 m from the surface. The deposits are overlain by 12-60 m of Quaternary alluvium (Foster, 1991).

The results of several prior soil surveys indicated somewhat elevated Hg, but in general, conventional soil methods were not effective in locating the ore bodies (Smith, 1992). However, biogeochemical surveys that were conducted between 1985-1986, and Enzyme Leach [tm] surveys conducted in 1987 showed the concealed mineralization clearly. This paper presents only the biogeochemical results.

Five biogeochemical survey lines were sampled on 30 m centers using sagebrush (A. tridentata): SCS-A, SCS-B (both in 1985), PIN-1, PIN-2, and PIN-7(all in 1986). The location of these lines is displayed in Figure 17, which also shows two airborne-EM & Magnetic flight lines, Enzyme Leach [tm] lines, and other lines south of the ore body that are not part of this discussion. Foster (1991) concludes that VLF-EM (1971) over the Mag deposit were inconclusive. Also, CSAMT and Phase Induced Polarization Surveys (1988-89) indicate a broad hydrothermally altered area revealed by a low resistivity anomaly. However, this seems to be more indicative of wet clays, sulfide, and the carbon content of the host rocks, rather than Au mineralization. Later resistivity and magnetic surveys (1994) were equally inconclusive.

Figure 18 presents some of the 1985 data from Line SCS-A. There is an enormous response to the Mag deposit as indicated by Au and As. Tungsten and Sb also respond well to mineralization. Bromine anomalies are more pronounced over structures, as is Hg from a soil-gas buried collector survey that was conducted at the same time. The response to the CX deposit is lost in the overwhelming magnitude of the anomalies related to the Mag. A discussion of pattern recognition and a redefinition of “anomaly” (Smith, 1992) is necessary if deposits like the CX

are to be recognized. Systematic bumps in the geochemical profiles of Au and Br are the signature pattern for the CX deposit. We see this signature again on SCS-B (Figure 19) for Br (over ore) and Au (up-dip extension of the mineralized shear zone). The depth of the water table also affects the strength and location of the trace metal concentrations. Note that mineralization below the ground water table provides a greater pool of ions that are ultimately available to shrubs than mineralization above the water table. This pattern has important bearing on determining where the deepest ore relative to the ground water table will be found.

Line PIN-2 (Figure 20) was surveyed after the Mag pit was opened, consequently samples from the middle of the survey line could not be taken. It lies between the SCS-A and SCS-B lines that were surveyed a year earlier. The geochemical profile for Br shows a strong up-dip response to the Mag deposit, while Au and As are more responsive to deep mineralization at depths where ground water is actively oxidizing ore.

Lines 1 & 7 (Figure 22) lie over newly discovered ore based on drilling in 1986. As before, the biogeochemical profiles over this part of the Mag ore body are extremely responsive to deep mineralization that is in contact with ground water. Gold spikes relate to structure, and Br on Line 1 displays a “rabbit ears” pattern. The zone of ground water / ore interaction seems to have the greatest effect on trace metal accumulations in sagebrush.

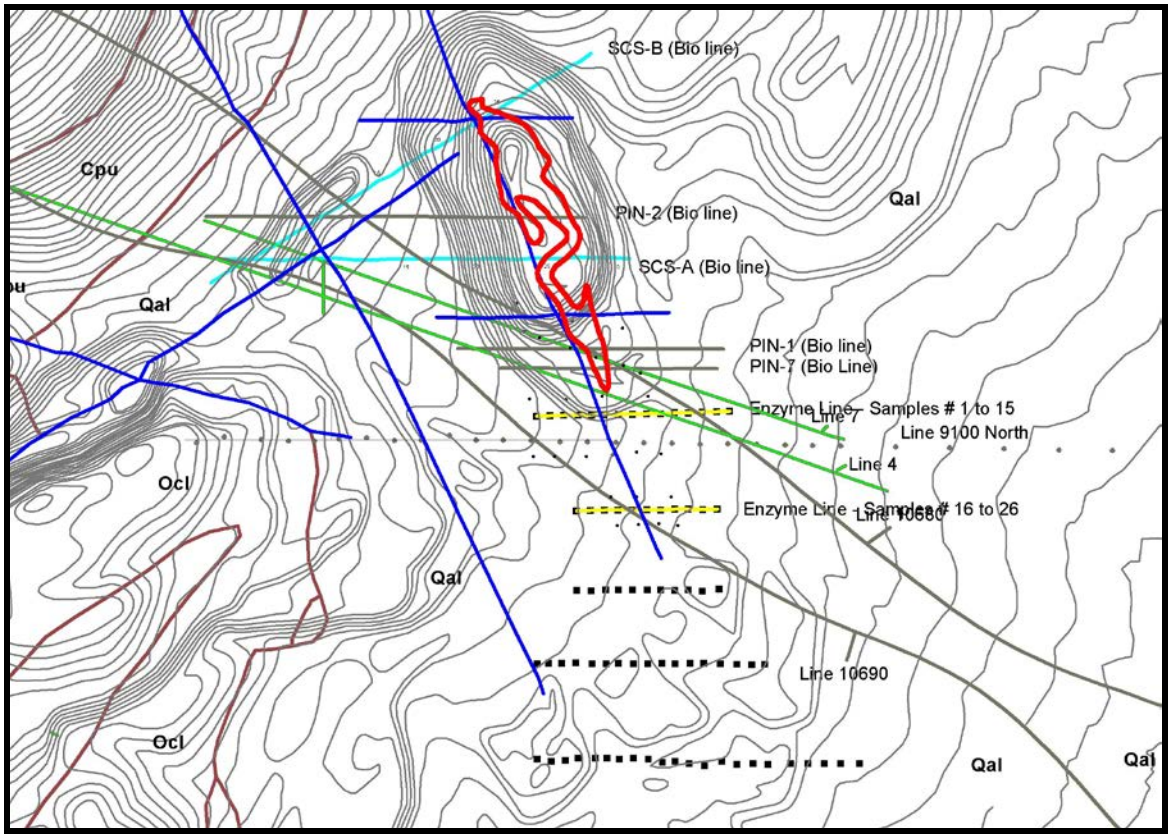


Figure 17. Topography, geology, biogeochemical survey lines, and the location of the Mag Ore Body (red), 1994. Only data for SCS-A, SCS-B, PIN-1, PIN-2, and PIN-7 are discussed.


Fig 17a. Google Image (1990) of the CX and Mag pits at the Pinson Mine.


Fig 17a. Google Image (1990) of the CX and MAG pits at the Pinson Mine, showing biogeochemical pre-mining survey lines (1985) over the MAG deposit.

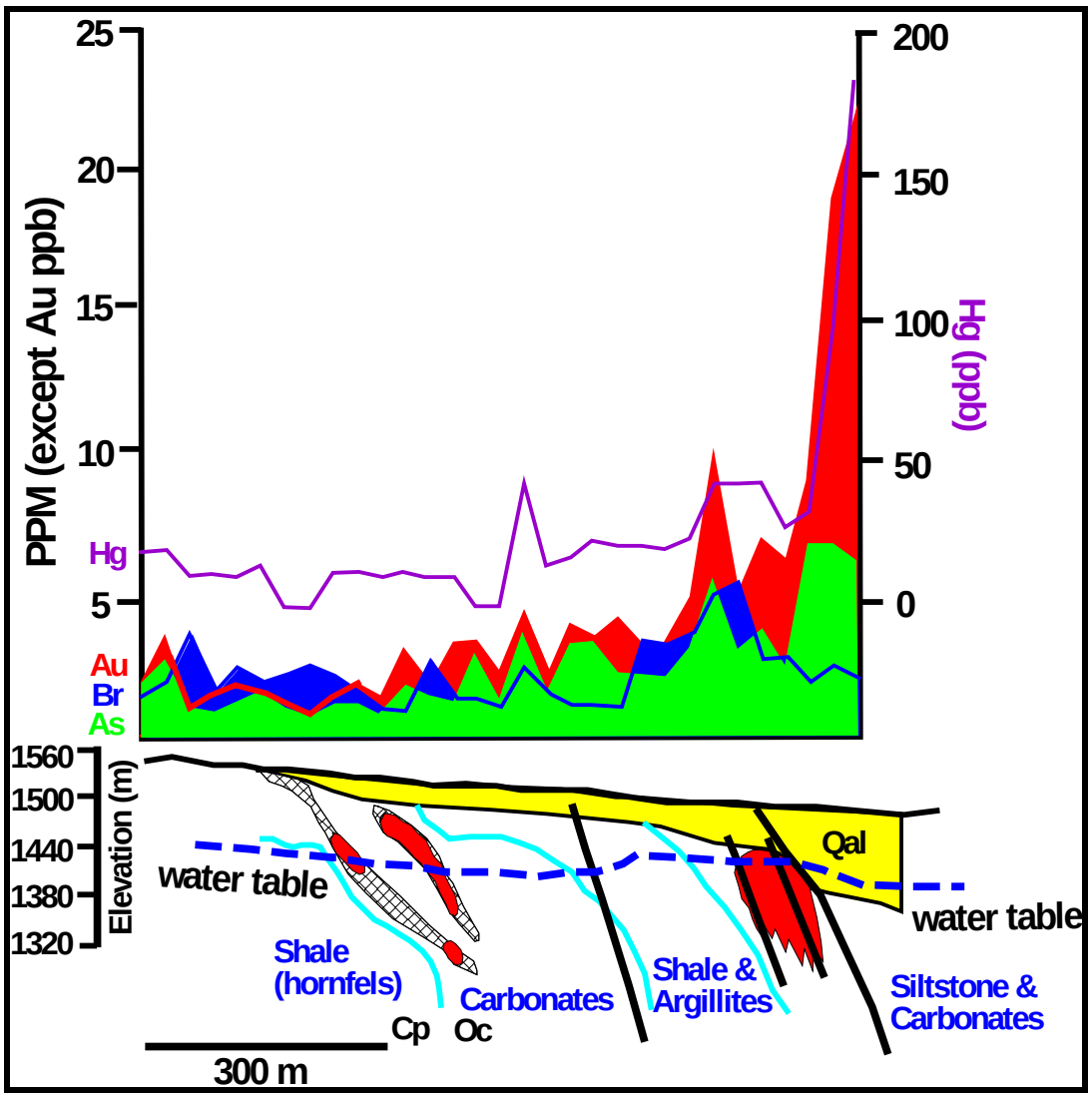


Figure 18. Metal concentrations in sagebrush from line SCS-A, and Hg data from buried collectors, registered to a cross-sectional representation of the geology, showing contacts (Lt Blue), structures (black), water table (blue dashed), and ore bodies (red).

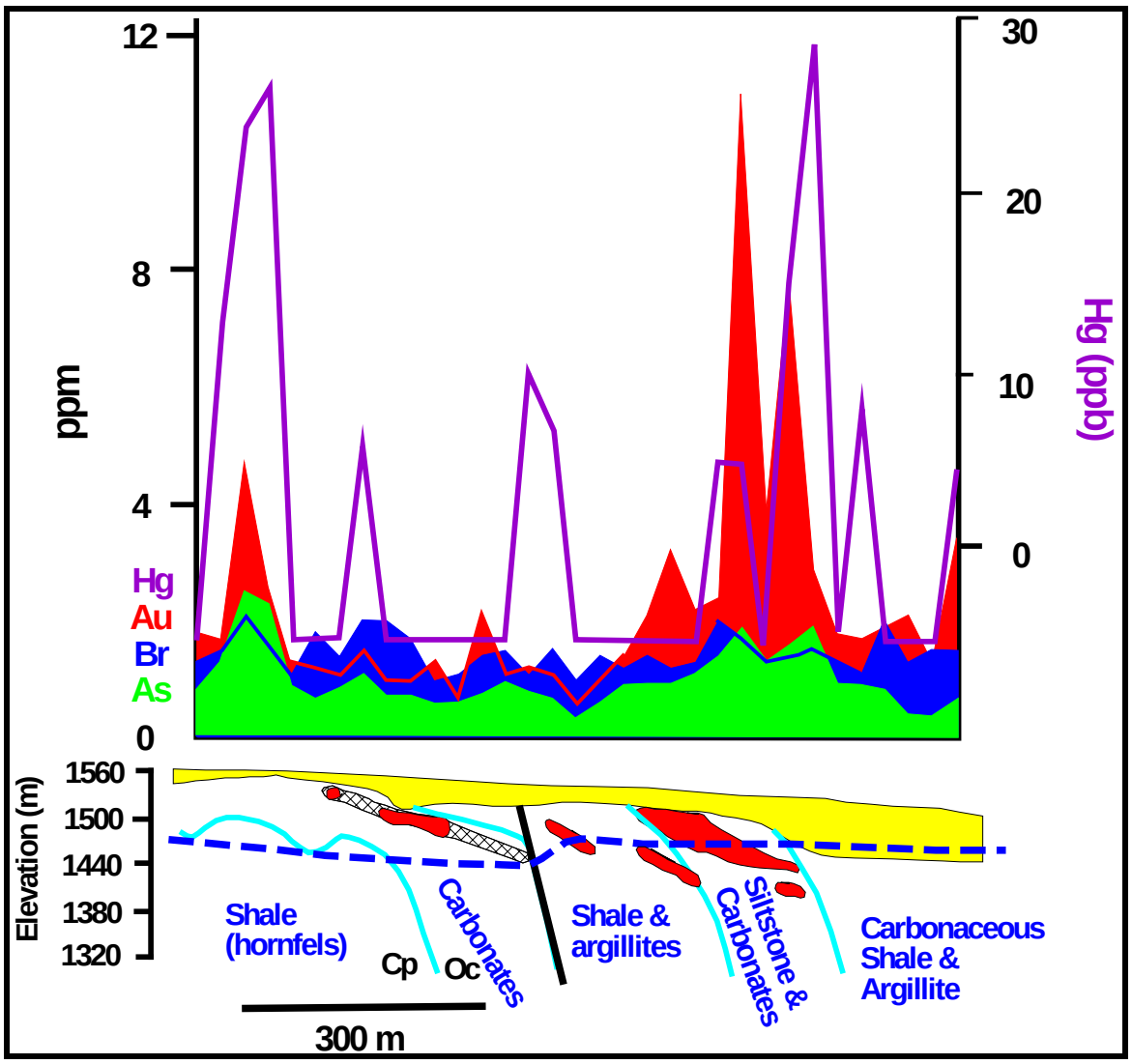


Figure 19. Metal concentrations in sagebrush from line SCS-B, and Hg data from buried collectors, registered to a cross-sectional representation of the geology, showing contacts (Lt.Blue), structures (black), water table (blue dashed), and ore bodies (red).

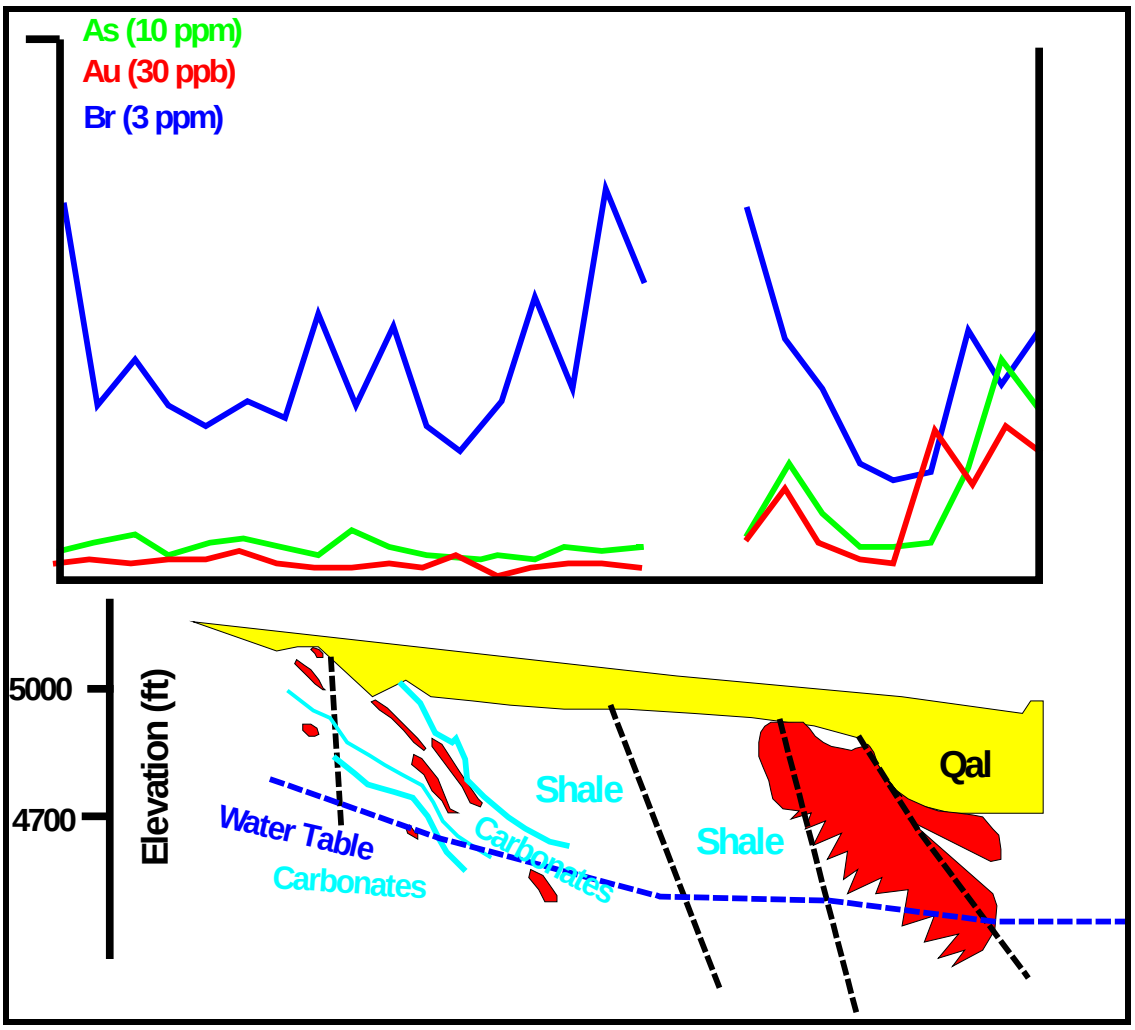


Figure 20. Metal concentrations in sagebrush from line PIN-2, registered to a cross-sectional representation of the geology, showing barren Quaternary alluvium, contacts (Lt.Blue), structures (black dashed), water table (blue dashed), and ore bodies (red).

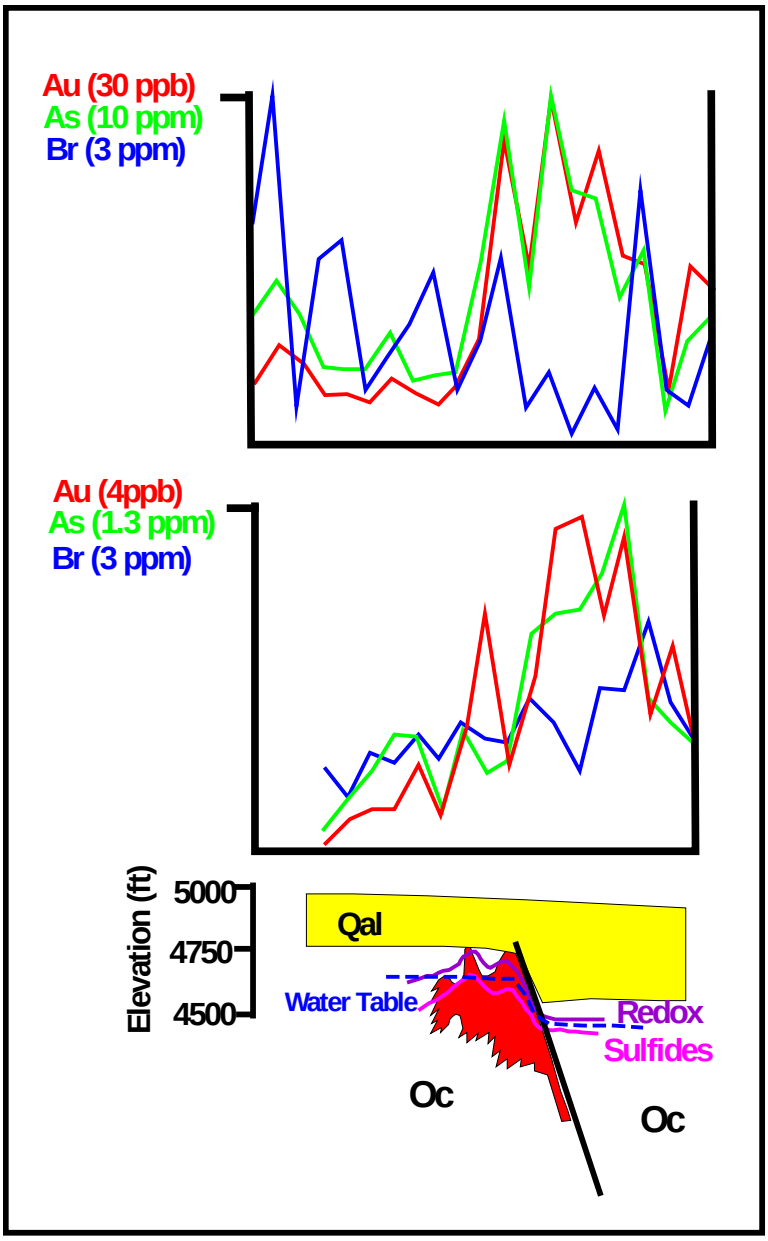


Figure 21. Metal concentrations in sagebrush from lines PIN-1 and PIN-7, registered to a cross-sectional representation of the geology, barren Quaternary alluvium, structures (black), water table (blue dashed), and ore bodies (red).

The biogeochemical surveys over the Mag and CX deposits have provided the mineral exploration community with some of the best examples of biogeochemistry at work. There have been several other investigative surveys at Pinson, one of which was a bee pollen survey conducted in 1988. The results compare favorably to all of the other biogeochemical surveys, but with the added advantage that the bees did all of the fieldwork.