Primary structural control of epithermal mineralized shoots in southeastern Chloride mining district, New Mexico

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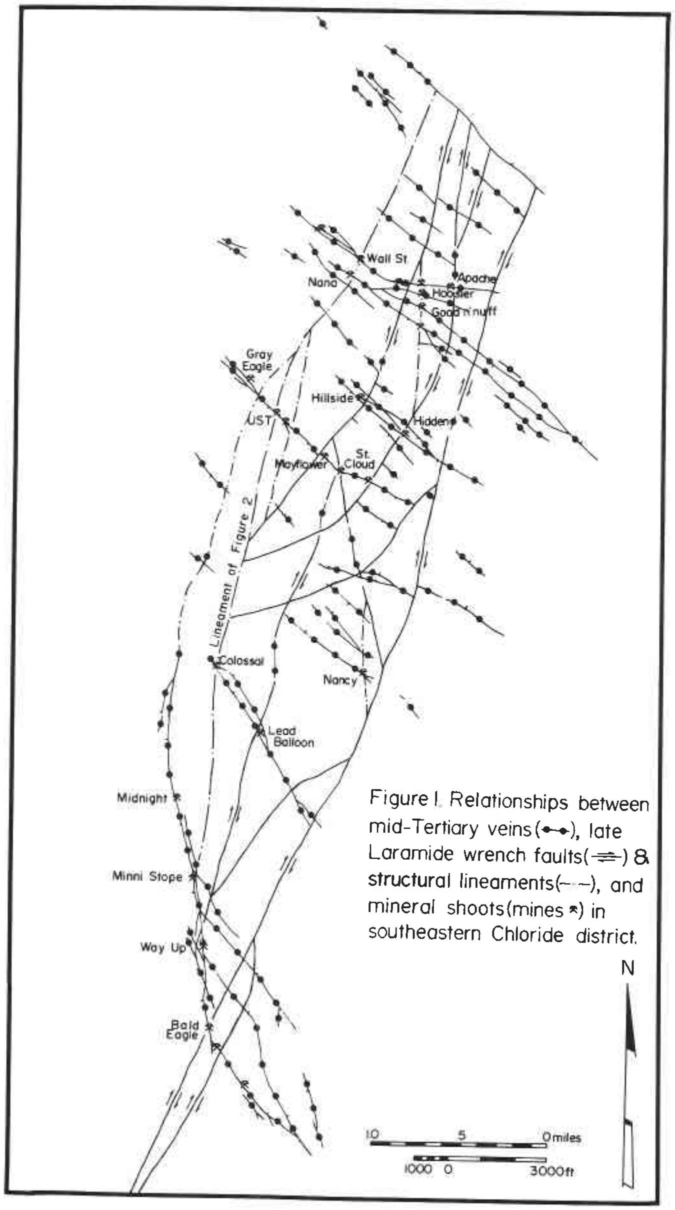

Figure 1. Relationships between mid-Tertiary veins (•—•), late Laramide wrench faults (⇌) & structural lineaments (– –), and mineral shoots (mines ☆) in southeastern Chloride district.

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Known occurrences of ore-grade epithermal mineralization in the southeastern portion of the Chloride mining district, Sierra County, New Mexico, are localized primarily along intersections of mid-Tertiary high-angle normal faults and early Tertiary near-vertical wrench faults. Approximately two million ounces of silver, ten thousand ounces of gold, ten thousand tons of base metals, and more than fifty thousand tons of high-silica smelter flux have been produced from rock in and adjacent to these intersections.

Early Tertiary wrench faulting cut through the Chloride mining district along a north–northeast-trending zone. Many strands of braided near-vertical strike-slip faults developed across this zone. Right-lateral horizontal offsets of 0.8 and 0.7 miles (1.3 and 1.1 km) occurred across two of the strands (Harrison, 1987). Wrench faulting in the Chloride area is part of major dextral wrench faulting that occurred along the eastern margin of the Colorado Plateau during a late Laramide tectonic event (Chapin and Cather, 1981; Chapin, 1983).

Late Oligocene high-angle normal faults related to initial development of the Rio Grande rift in southwestern New Mexico are the primary host structures for epithermal quartz–calcite–sulfide veins in the southeastern portion of the Chloride district (Harrison, 1986). Vein systems in this area dominantly trend northwest–southeast; this agrees with determinations of regional least-principal-horizontal stress direction for this time period (Zoback and others, 1981; Aldrich

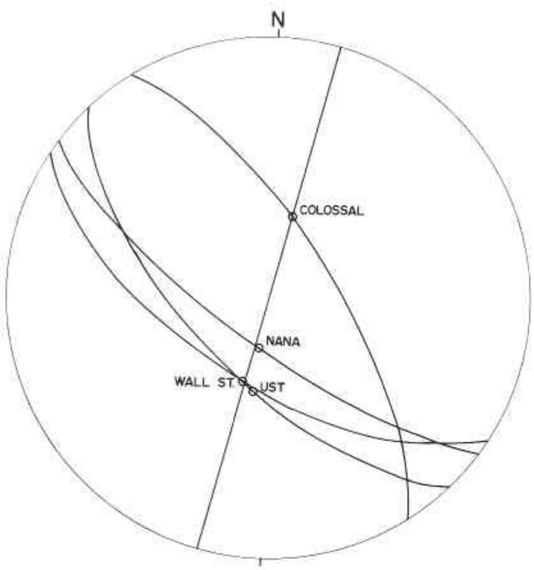
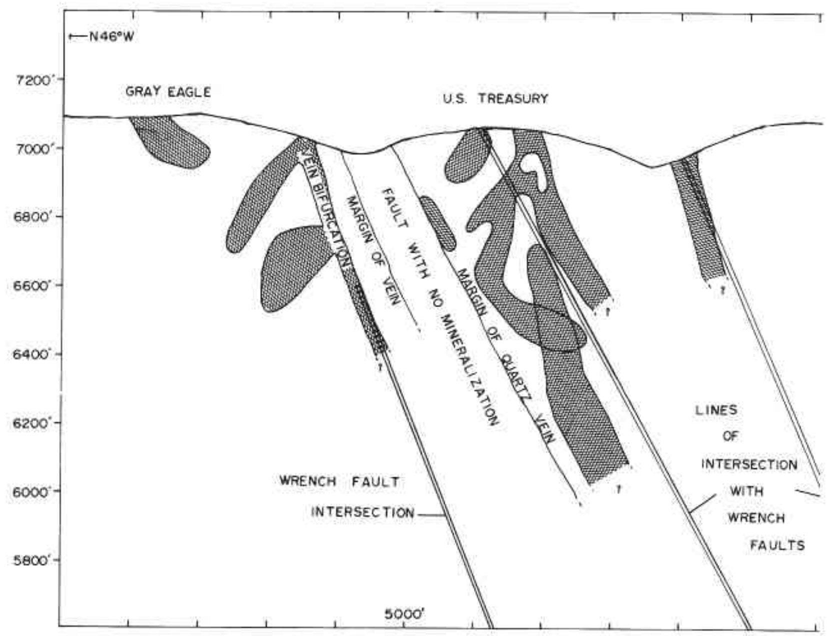


FIGURE 2—Equal-area stereographic projections (lower hemisphere) of four veins in southeastern Chloride mining district showing bearing and plunge of mineral shoots (circles) along NNE near-vertical structural lineament.



and others, 1986). A notable exception to this trend is the north–northwest-trending Pye Lode along which the Midnight, Minnistope, and Bald Eagle mines are located (Fig. 1). Dip slips on vein-filled faults in southeastern Chloride district range from a few to several hundreds of feet.

Known occurrences of base- and precious-metal sulfide deposits are restricted virtually to intersections of vein-filled normal faults and Laramide wrench faults or structural lineaments believed to be buried wrench faults. Figure 1 is a structural map of the southeastern portion of the Chloride district showing relationships between structural intersections and mined mineral deposits. Even though the vein systems have long strike lengths of barren or low-grade mineralization, areas of economic or near-economic mineralization occur only along the structural intersections.

Stereographic projections commonly are used by geologists to view and analyze linear and planar geometric features. The projection is made by plotting where structural features would intersect the lower half of a hollow sphere when viewed from a point directly above the center of the sphere. Planes, such as veins or faults, are plotted as straight lines if they are vertical or as curved lines if they dip less steeply. The lines curve in the direction of dip and increase in curvature as the dip flattens. Lines, such as the inersection of two planes, are plotted as a point where that line intersects the outer surface of the hollow sphere. The location of the point is a function of the bearing and plunge of the line. Figure 2 shows stereographic projections of the Colossal, U.S. Treasury, Nana, and Wall Street vein systems as curved lines, and the linear orientations (bearing and plunge) of mineral shoots within the veins are shown as points on these lines. As can be seen readily from this figure, all four points lie on or very near a north-northeast-trending straight line on the stereographic projection. This straight line is the projection of a near-vertical plane that coincides with the structural lineament (buried wrench fault) shown in Figure 1 and displays the primary control on mineral deposition by intersections between veins and wrench faults.

Figure 3 is a longitudinal section of the St. Cloud–U.S. Treasury vein system that serves as a cross section through the north–northeast-trending wrench-fault zone. All known occurrences of ore-grade mineralization (hachured areas) are centered on wrench-fault intersections. Details of mineralized shoots occurring at the vein–wrench-fault intersection at the U.S. Treasury mine are shown in Harrison (1988). Fault separation of limestone (favorable zone of Freeman and Harrison, 1984) at the St. Cloud deposit is a well-mineralized, secondary structural control.

The deeply penetrative wrench-fault structures presumably served as primary conduits for upwelling, metal-bearing hydrothermal fluids. Sulfide deposition occurred in near-surface aquifers from either mixing and/or boiling processes, dominantly along wrench-fault intersections with shallow tensile fractures.

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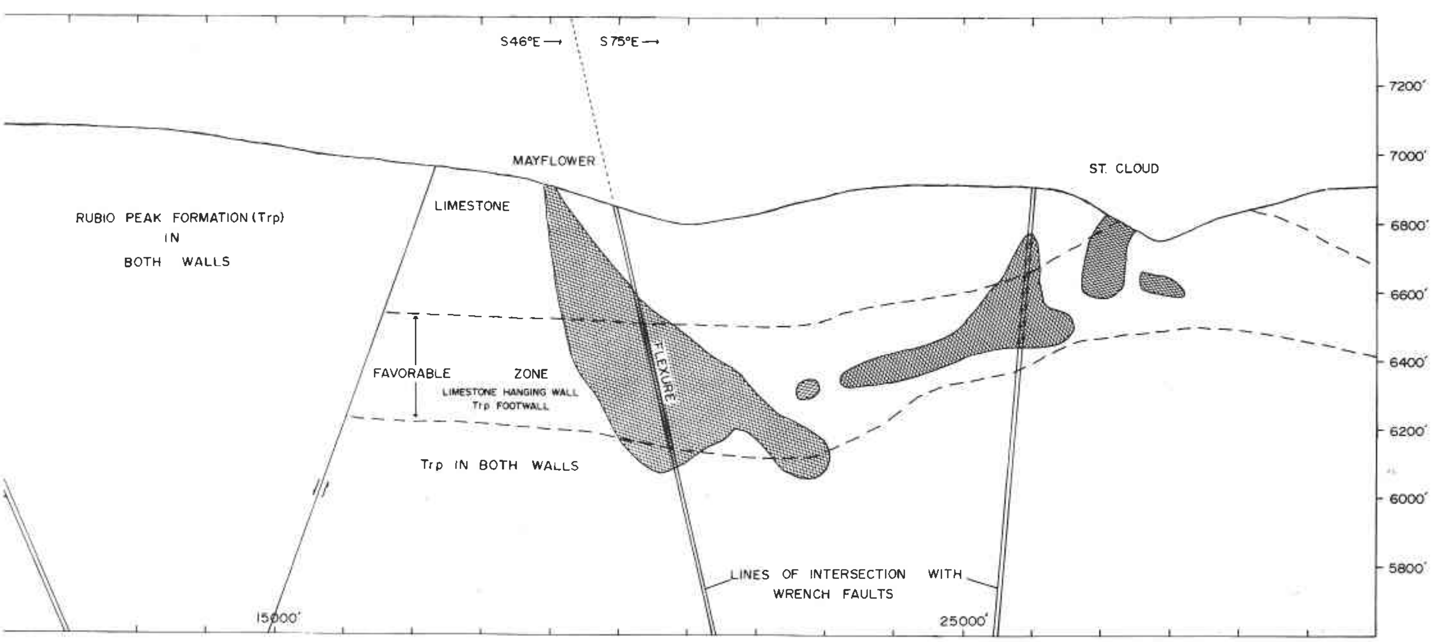

FIGURE 3—Longitudinal section of St. Cloud–U.S. Treasury vein system.