Fault-surface Map Restorations of San Manuel-Kalamazoo: Reassessing the Tilting History

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This study uses fault surface maps to determine the direction and amount of slipping on normal faults in the vicinity of the San Manuel-Kalamazoo porphyry Cu-(Mo) deposit, Arizona. Data from drill holes, crosscutting relationships, and stereonet rotations of bedding attitudes in synextensional sedimentary rocks permit estimation of the initial orientations of faults and the amount of tilting of the ore shell.

Normal faults can be assigned to six fault sets. Sets are based on orientation and relative age relationships: (1) Cloudburst, (2) Turtle, (3) San Manuel, (4) Black Canyon, (5) Cowhead Well, and (6) Cholla. The present-day dips of faults range from high-angle (Cholla, Black Canyon), to moderate-angle (San Manuel), to subhorizontal and overturned (Cloudburst).

Three additional dismembered segments of the Cloudburst fault were identified concealed beneath younger rocks, as well as three segments of the Turtle fault. The erosion surface that bounds the eastern side of the Purcell window and overlies the Kalamazoo deposit consists of three segments separated by inflections in dip. Successively deeper segments of the erosion surface dip more steeply to the east, at ~20°, ~30°, and ~60°. Both the presence of a 60°E-dipping segment of the erosion surface on the Purcell window and a small, gently-dipping segment of the Cloudburst fault in the footwall of the Turtle fault are compelling geologic evidence that the Turtle fault cuts and offsets the Cloudburst fault and does not constitute a lateral ramp to it. All faults contribute to tilting of the San Manuel-Kalamazoo ore shell, which has been tilted ~62°E, similar to dips of the oldest Tertiary rocks. The axis of the ore shell has a current trend of S57°W and a plunge of 20°SW; the original, restored axis trends S56°W and plunges ~82°SW, implying that the axis of the orebody was emplaced within ~8° of vertical.