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Evaluation of the Role of Sulfidation in Deposition of Gold, Screamer Section of the Betze-Post Carlin-Type Deposit, Nevada

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Abstract

This study was undertaken to evaluate the relation between sulfidation and gold deposition in the Screamer section of the Betze-Post Carlin-type deposit. We also attempted to determine the source of sulfur in the deposit and the possibility that more than one gold-depositing event contributed metal to the Screamer system. Gold ore at Screamer forms a generally stratiform body hosted largely by the Wispy member of the Devonian Popovich Formation and lacks obvious alteration of wall-rock gangue minerals. Gold at Screamer is hosted by arsenian pyrite that forms disseminated grains and overgrowths on diagenetic pyrite. A strong correlation is observed between the gold content of rock samples and their proportion of ore-related (arsenian) pyrite, as determined by point counts.

Isocon plots show that mineralization at Screamer involved addition of both sulfur and iron, along with gold, arsenic, antimony, tungsten, and local silica, barium, and phosphorus. Fe/Al vs. S/Al plots show that most ore samples at Screamer do not contain enough sulfur to account for all of their iron as pyrite; petrographic examination shows that the iron occurs in pyrite, ferroan dolomite, and iron-bearing micas in order of decreasing abundance. The Fe/Al vs. S/Al plots also show that Screamer samples with high gold contents contain more pyrite than samples with low gold contents and that samples inside the ore zone have more pyrite than those in the surrounding area. These relations are interpreted to indicate that Screamer has undergone at least two pyrite-forming events. The first event, which probably took place during diagenesis, involved incomplete sulfidation that left some iron in carbonate and silicate minerals. The second event, which probably took place during gold mineralization, sulfidized most remaining iron and added pyrite in the Screamer ore zone.

The $\delta^{34}S$ values of chemically extracted sulfur from disseminated pyrite at Screamer range from –13.8 to 16.5 per mil, and $\delta^{34}S$ values for hand-picked separates of pyrite and other sulfides in veins cutting these rocks range from –21.2 to 11.7 per mil. A significant fraction of samples with high gold contents and of samples in the ore zone regardless of gold content have $\delta^{34}S$ values between –1 and 5 per mil. These data suggest that early diagenetic sulfur with a wide range of $\delta^{34}S$ values was overprinted by sulfur with isotopic compositions in the –1 to 5 per mil range that was associated with gold mineralization. The $\delta^{34}S$ values for gold-related sulfur at Screamer are lower than those reported for bulk mineral separates from most other Carlin-type deposits and from SIMS analyses of sulfides from the proximal Post part of the Betze-Post system and could be magmatic. Limited evidence can be found for multiple gold-forming events in the Screamer zone. Tungsten, which might have been introduced by the Jurassic-age Goldstrike stock, is widespread in the deposit and correlates closely with gold. A few samples with high tungsten/gold ratios found along fault zones might be part of an earlier phase of mineralization related to the Goldstrike stock. A $\delta^{34}S$ value for pyrite in one of these samples is similar to the high values reported for sulfides in auriferous, polymetallic mineralization in the Post section of the deposit, but this mineralization is not reported to contain tungsten. Other veins containing sphalerite have lower $\delta^{34}S$ values and lack consistent gold values.

Whereas there is no correlation between gold values and the degree to which the host rocks have undergone sulfidation, there is a strong and highly significant correlation between gold values and the abundance of ore-related pyrite. This shows that simple sulfidation of immediately adjacent wall rock cannot account alone for gold deposition at Screamer and it might not be the only ore-depositing process in some other Carlin deposits. A more general, "extended sulfidation" process could be important, however. One likely process involves mixing of an invading, mineralizing fluid containing sulfur and gold with a wall-rock fluid containing iron derived from adjacent or distal wall rocks. Recognition of the source(s) for this iron and fluid flow pathways responsible for introducing it to the ore zone could provide useful guidance in exploration for the next Carlin trend.

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