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DISCUSSIONS

CHARACTERIZATION AND DATING OF ARGILLIC ALTERATION IN THE MERCUR GOLD DISTRICT, UTAH—A DISCUSSION

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Sir: Wilson and Parry (1995) present data pertaining to clay alteration and K-Ar age dates for samples from the Mercur gold district. Their data record a wide spread of K-Ar ages for illite ranging from 98.4 to 226 Ma. They estimate the age of gold mineralization to be between 140 and 160 Ma and explain the wide range of ages as functions of partial thermal resetting of the clay minerals and the distance from the hydrothermal conduits. Morris and Tooker (1996) in their discussion of this paper, point out that a Mesozoic age for gold mineralization at Mercur is incompatible with several lines of long-standing regional geologic evidence that suggest a Tertiary age. In their reply, Wilson and Parry (1996) defend their position for a Mesozoic age of mineralization in part by relying on new $^{40}Ar/^{39}Ar$ age data and the fact that none of the 22 age dates is Tertiary. Although the research by Wilson and Parry may represent a good study of samples in the laboratory, there are several tenuous assumptions and contradictions of the geologic observations at Mercur that must be addressed.

Wilson and Parry (1995, p. 1197) report that "completely argillized and highly mineralized limestone obtained from the Carrie Steele fault yields an age of 152 ± 4 Ma" which they state is the best estimate of the age of the gold-bearing hydrothermal event on this fault. In their table 4, Wilson and Parry (1995, p. 1209) report that sample CS-9 is the sample yielding this specific K-Ar age. In their table 3, Wilson and Parry (1995, p. 1207) indicate the gold content of CS-9 to be <1 ppb Au. In fact, the maximum gold value for all five of the samples from the Carrie Steele fault for which they report K-Ar age dates is 6 ppb. These samples would not be considered "highly mineralized" by most workers.

According to these same tables (Wilson and Parry, 1995), the five samples from the Mercur pit with K-Ar age dates carry better, but still rather low grade, gold values (47–810 ppb Au). These Mercur pit samples, as well as the Carrie Steele fault samples, also contain elevated values of As, Hg, Sb, and Tl, elements that are commonly considered part of the trace element suite of Carlin-type deposits such as Mercur. Although it may seem obvious that these samples were affected by the gold-bearing hydrothermal event, it is just as likely that the presence of these trace elements in the samples is related to ground-water remobilization during weathering of the adjacent gold deposit. Wilson and Parry (1995) admit in their closing statement that they lack petrographic evidence relating the gold mineralization to illite precipitation. Without such evidence, one should not assume that the illite K-Ar age dates represent the age of gold mineralization, especially when geochemical evidence casts doubt on the association of the dated illite with gold.

Contrary to their closing paragraph (Wilson and Parry, 1996), there is abundant evidence that the gold mineralization is younger than the Tertiary magmatic events of the Mercur district. These events include the intrusion of the Porphyry Knob quartz monzonite dikes at 36.7 ± 0.5 Ma (Moore and McKee, 1983) and the intrusion of the Eagle Hill Rhyolite dikes and sills at 31.6 ± 0.9 Ma (Moore, 1973).

The most striking visual observation in the highwall exposure of the Sacramento pit is the ~20-m-thick zone of black, sooty organic material that appears to be ponded beneath the buff-colored sill of Eagle Hill Rhyolite. This organic material is observed to invade fractures in the rhyolite sill at its lower contact. Tafuri (1987) identified the organic material as asphaltene and activated carbon, most likely derived from a precursor mobile hydrocarbon that circulated in the hydrothermal system which deposited the gold. If this is true, the field relations suggest that the sill was in place prior to mineralization.

The late stages of mining in the Sacramento pit revealed a large block of the Eagle Hill Rhyolite sill that was downdropped along a series of closely spaced faults. The Sacramento gold orebody occurs within this fault zone and the adjacent favorable stratigraphy. The faults that displace the rhyolite do not displace the orebody. These observations indicate that the faults and the mineralization postdate the intrusion of the sill.

The Eagle Hill Rhyolite carries low-grade mineralization in several locations. Stanger (1988), in a review of 86 drill holes that intersected Eagle Hill Rhyolite, reports that 44 percent of these holes intersected gold-bearing rhyolite with values ranging from 69 to 926 ppb Au. For example, drill hole SU-2 contained 84 m of weakly argillized rhyolite that carried erratic gold values from <34 to 412 ppb Au. For comparison, samples of the rhyolite from outside the mine areas show background values of <5 ppb Au. Although the Eagle Hill Rhyolite typically carries subore grades, it is apparent that a large volume of the rhyolite was affected by the gold-bearing hydrothermal system. The low gold values can be attributed to the fact that the dense rhyolite is simply a poor host rock.

Tafuri (1987) described a small exposure of a gold-bearing "breccia pipe" at Marion Hill which contained igneous clasts. The final stages of mining conducted at Mercur in 1996 and 1997 revealed that this exposure is part of a much larger breccia body that hosted most of the gold (79,356 oz Au) mined from the Ingersoll cut of the Golden Gate pit. The

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breccia body is roughly circular in plan view, with a diameter of about 365 m. It is heterolithic and contains unstratified, angular to subrounded clasts of lithologies that occur both stratigraphically above and below the typical Mercur series host rocks, as well as clasts of igneous rock. DePangher (1997) identified the igneous clasts as microspherulitic felsic porphyry. Widespread monocyrstalline quartz and biotite within the matrix of the breccia are probably phenocryst fragments derived from the porphyry. Although the nature of this breccia is not yet clearly understood and the age of the igneous clasts has not yet been established, it is clear that the gold mineralization postdates the intrusion and brecciation of a felsic igneous body. Considering that the only known igneous events in the Oquirrh Range are Tertiary in age, it is most likely that the breccias and gold mineralization are also Tertiary or younger.

In summary, the Mesozoic K-Ar age dates presented by Wilson and Parry are suspect because the dated illite cannot be directly tied to gold mineralization and there is overwhelming field evidence to support a Tertiary age for mineralization. Perhaps additional investigations are in order to determine why the illites were not thermally reset during gold mineralization. It is possible that the only rocks affected by the hydrothermal system were those with sufficient permeability and porosity in the immediate areas of gold deposition, rather than the huge volumes of mineralized and unmineralized rock envisioned by Wilson and Parry. Regardless of the reason, it remains apparent that reliable radiometric age dates of the hydrothermal events in these Carlin-type gold deposits are difficult to obtain.

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CHARACTERIZATION AND DATING OF ARGILLIC ALTERATION IN THE MERCUR GOLD DISTRICT, UTAH—A REPLY

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Sir: We thank David Mako for his comments, discussion, and additional information on the Mercur gold deposit, Utah. In his discussion David Mako presents reasons why he believes a Tertiary age should be assumed for gold mineralization within the Mercur gold district. We would like to respond to his comments and reassert our view that, given all the evidence currently available, the best interpretation is that Mercur is not a Tertiary deposit.

David Mako presents several points where he feels our paper (Wilson and Parry, 1995) is in error. We would like to respond to these points sequentially. First, Mako suggests that, because the gold contents of the specific samples which we dated are low, these dates do not date gold deposition. However, Wilson and Parry (1995) included maps which we used to mark exactly the location of samples within the deposits, to associate samples with ore grade and ore zone (information provided by Barrick), and to show that many of our samples came from high-grade areas of the deposits. In addition,the highly variable gold content within ore zones is typical of sediment-hosted disseminated gold deposits (Ashton, 1989) and it is not surprising that many individual samples within orebodies are not of high grade. We also note that the range in gold content of our dated samples is essentially the same as that of the gold values which Mako uses later in his discussion to indicate that the Eagle Hill Rhyolite is mineralized. There is no doubt that many of our Mesozoic dates came from samples within high-grade portions of the Mercur mine.

In a related point, Mako suggests that, although our dated samples were high in heavy metals which are characteristically associated with gold in sediment-hosted disseminated gold deposits, this chemical signature was produced by groundwater remobilization and that we were not obtaining samples from the gold deposit itself. Examination of our sample location figures (Wilson and Parry, 1995) clearly shows our samples were obtained from areas of the mine which were actively being mined for gold at the time of sampling. We also note that all of our sampling was done with the guidance of mine geologists, particularly Larry Stanger. There is no doubt that our samples are from within ore zones of the deposits.

Third, Mako assumes that the deposits are Tertiary in age because the igneous intrusions in the district are Tertiary. The many problems with this assumption were discussed in Wilson and Parry (1995). Of those arguments, our main points continue to be that the mineralization extends far beyond any possible area which we calculated would have been affected by the thermal aureole of the intrusion, and that none of the ages obtained from within the ore zones are Tertiary in age, something we would expect in a Tertiary deposit. One of our more conclusive ages was from sample MLT-11, from a vein of illite and pyrite located within 30 m of the Eagle Hill Rhyolite contact with an age of 147 ± 6 Ma. The lack of thermal resetting in this sample supports our calculations that

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