

## Robust Re-Os Molybdenite Ages for the Hemlo Au Deposit, Superior Province, Canada

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The Re-Os chronometer in molybdenite has been amply demonstrated to be remarkably robust, enduring extreme geologic conditions, including granulite facies metamorphism (Raith and Stein, in press) and intense deformation (Stein et al., 1997). Recent literature, however, errs by labeling the chronometer as fallible, for example, in the presence of fluids commonly associated with hydrothermal alteration (Suzuki et al., 2000).

To establish laboratory credibility, we routinely run several fine-grained molybdenite standards. If a molybdenite standard cannot be precisely replicated in a laboratory, difficulty in repeating the age of a geologic sample likely stems from analytical problems in the laboratory. In addition, we have found that Re and  $^{187}\text{Os}$  are decoupled within individual molybdenite grains, because the  $^{187}\text{Os}$  appears to concentrate in discrete domains (Scherstén and Stein, unpublished data). Therefore, for geologic samples, we replicate Re-Os data, not only for carefully homogenized single mineral separates, but more importantly for mineral separates derived from different points within a specimen or from among several widely spaced specimens representing the same mineralizing event (Stein et al., 1998). In this way, a positive result (i.e., agreement among Re-Os ages from different samples) can never be argued as replication of a disturbed age. We believe that erroneous laboratory results have been wrongly used to discredit the Re-Os chronometer in a number of situations.

The Hemlo Au deposit provides another excellent opportunity to demonstrate that the Re-Os chronometer is entirely intact in an environment that is known to have experienced multiple overprinting hydrothermal events. The Hemlo Au deposit is located within the E-W trending, Late Archean upper greenschist to middle amphibolite Hemlo-Heron Bay greenstone belt in the Superior province. The belt is marked by two major periods of volcanism (~2772 and ~2695 Ma), and three major pulses of granitoid plutonism (~2719, ~2688, and ~2678 Ma). The Hemlo Au ore bodies, associated with three major mines (Williams, Golden Giant, David Bell) are localized in the Lake Superior shear zone. Hemlo molybdenite is extremely fine-grained (providing a naturally homogeneous mineral separate) and the mineralization is clearly deformed as it parallels the intensely foliated host rock fabric. Molybdenite and green vanadiferous muscovite are consistently associated with Au ore, whereas there is no apparent relationship between pyrite and Au content at Hemlo. The Re concentrations for Hemlo molybdenites are unusually low (up to 3.7 ppm), with one sample containing only 0.1 ppm Re, providing an added analytical challenge. For six analyses on five different mineral separates from samples repre-

sented three mines, all molybdenite Re-Os model ages overlap within their 2-sigma uncertainty, indicating closed Re-Os systematics and excluding the possibility of local resetting or erratic isotopic disturbance from a post-depositional event. In addition, we obtained a Re-Os isochron of  $2665 \pm 18$  Ma (MSWD = 4.9) with the expected initial  $^{187}\text{Os}$  intercept of zero ( $-0.01 \pm 0.48$  ppb), since molybdenites do not contain significant common Os (Figure 1). If the isochron reflected widespread and full isotopic resetting of molybdenite (noting that, based on other studies, we observe that molybdenite is not reset), the  $^{187}\text{Os}$  intercept should be distinctly positive, and not zero. If the lowest Re-Os model age (our first analysis) is removed from the calculation, a five-point Re-Os isochron yields an age of  $2670 \pm 17$  Ma with a similar MSWD and intercept. In either case, the Re-Os age is in excellent agreement (2-sigma overlap) with other age estimates (U-Pb on titanite,  $^{40}\text{Ar}/^{39}\text{Ar}$  on vanadiferous muscovite) for Hemlo Au (Mo) mineralization, ranging from about 2677 to 2665 Ma (Corfu and Muir, 1989; Masliwec et al., 1986).

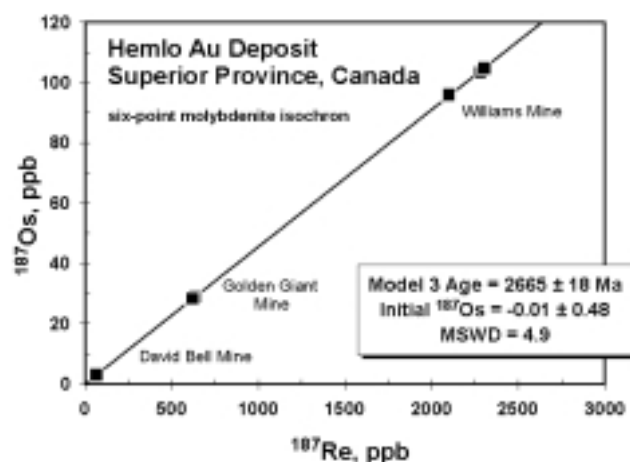


Figure 1: Molybdenite Re-Os isochron for the Hemlo Au(Mo) deposit, Ontario, Canada

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