

High-Precision Re-Os Molybdenite Ages for Porphyry- and Skarn-Style Cu-Au Mineralization at Ok Tedi, Papua New Guinea

Peter J. Pollard,^{1,*} Robert W. Smillie,² Holly J. Stein,^{3,4} and Daniel R. Hastings²

¹Pollard Geological Services Pty. Ltd., 7 Jillinda Place, The Gap, QLD 4061, Australia

²Ok Tedi Mining Ltd, P.O. Box 1, Tabubil, Western Province, Papua New Guinea

³AIRIE Program, Dept. Geosciences, Colorado State University, Fort Collins, CO, USA

⁴Center for Earth Evolution and Dynamics (CEED), University of Oslo, Norway

*E-mail, peter@peterpollard.com

The OK Tedi mine has produced 4.4 Mt Cu, 13.6 Moz Au, and 28.3 Moz Ag since 1981 and has current resources of 3.9 Mt Cu and 15.1 Moz Au. Cu-Au mineralization occurs in and around the 1.1 to 1.4 Ma Ok Tedi intrusive complex, which is hosted within Ieru siltstone (Cretaceous) and Darai limestone (Miocene). Skarn-endoskarn Cu-Au mineralization is associated with porphyritic monzodiorite and Sydney monzodiorite intrusions in the southern part of the pit, and porphyry-style mineralization is mainly associated with the Fubilan monzonite porphyry in the northern part of the pit, but also extends into the southern intrusions and siltstone host rocks.

Re-Os dating of a paragenetically constrained suite of molybdenite samples has been carried out using the double Os spike technique, which allows determination of the amount of radiogenic ¹⁸⁷Os as well as the amount of common Os in the sample, while simultaneously correcting for instrumental mass fractionation. For young porphyry Cu-Au systems with molybdenites containing hundreds of ppm Re, two-sigma uncertainties on the Re-Os ages are only a few thousand years. We report only analytical uncertainties (i.e., omitting the component of error introduced by the ¹⁸⁷Re decay constant uncertainty).

The oldest dated mineralization is an endoskarn-hosted quartz-magnetite-epidote-carbonate-pyrite-chalcopyrite-molybdenite vein that provides an age of 1.3206 ± 0.0020 Ma for the Gold Coast skarn. This overlaps the 1.3031 ± 0.0015 Ma age for a quartz-pyrite-chalcopyrite-molybdenite vein with K-feldspar alteration in Ieru siltstone beneath the Gold Coast skarn. The youngest molybdenite ages correspond to molybdenite-only, pyrite-chalcopyrite-molybdenite, and quartz-pyrite-molybdenite veins in Fubilan monzonite porphyry and a quartz-K-feldspar-magnetite-biotite-chalcopyrite-pyrite-molybdenite vein in clinopyroxene endoskarn and adjacent Ieru siltstone that formed between 1.1326 ± 0.0034 and 1.1532 ± 0.0027 Ma. An intermediate stage of mineralization is recorded by a 1.2120 ± 0.0024 Ma quartz-K-feldspar-pyrite-molybdenite vein overprinting epidote-altered Sydney monzodiorite and a quartz-pyrite-molybdenite vein from Siltstone Ridge (1.2116 ± 0.0048 Ma).

These results show that Cu-Au mineralization at Ok Tedi formed in multiple events spanning at least 190,000 years (1.32–1.13 Ma). The youngest mineralization event represented by Cu-Au skarn in the Taranaki thrust overprints the Fubilan monzonite porphyry but has not yet been dated. The molybdenite ages also provide constraints on ages for some intrusive rocks. The Fubilan monzonite porphyry is older than the 1.1532 ± 0.0027 Ma age for crosscutting veins whereas the Sydney monzodiorite is older than the 1.3206 ± 0.0020 Ma age for the Gold Coast skarn.