

Re-Os and U-Pb Dating of the Vein-Hosted Mineralization at the Kansanshi Copper Deposit, Northern Zambia

HEIDIE I. TORREALDAY, MURRAY W. HITZMAN,

Department of Geology and Geological Engineering, Colorado School of Mines, Golden, Colorado 80401

HOLLY J. STEIN, RICHARD J. MARKLEY,

AIRIE Program, Department of Earth Resources, Colorado State University, Fort Collins, Colorado 80523-1482

RICHARD ARMSTRONG,

PRISE, Research School of Earth Sciences, The Australian National University, Canberra, ACT, Australia 02001

AND DAVID BROUGHTON

Cyprus Amax Minerals Company, 1501 West Fountainhead Parkway, Suite 290, Tempe, Arizona 85282

Abstract

The Kansanshi copper deposit in the Pan-African Damaran-Lufilian fold belt of northern Zambia consists of high-angle, sheeted quartz-carbonate-sulfide veins with envelopes of disseminated sulfides. These veins cut and replace metamorphosed Katangan sedimentary rocks of Neoproterozoic age. Crosscutting relationships have been used to delineate three stages of subparallel veins. The first two vein sets are chalcopyrite rich and contain minor molybdenite, and the third vein set contains relatively abundant molybdenite with significant monazite and brannerite and minor chalcopyrite. Direct dating of molybdenite (with replicates) from each of the vein sets using the Re-Os method yields two distinct ages, 512.4 ± 1.2 Ma and 502.4 ± 1.2 Ma (weighted averages, 2σ), consistent with the relative age relationships and vein mineralogies observed in the field. The molybdenite-monazite veins, which crosscut the two earlier chalcopyrite-rich vein sets, are distinctly younger (~ 10 m.y.), based on Re-Os dating. SHRIMP U-Pb analyses of monazite from the final veining event yield a U-Pb age of 511 ± 11 Ma. The $2s$ uncertainty of ± 11 m.y. includes all ages and $2s$ uncertainties provided by the Re-Os method. These results indicate that mineralization took place in the late Cambrian and suggest that either mineralization was continuous for 10 m.y. or the Kansanshi deposit includes two pulses of mineralization, one at ~ 512 Ma and one at ~ 502 Ma. Vein mineralogies and clear crosscutting relationships favor the latter suggestion. The ages of mineralization at Kansanshi are broadly similar to those determined for other posttectonic vein systems in the central African copper belt. Available geochronological data from deposits in the Damaran-Lufilian orogen suggest that a major mineralization event occurred throughout much of the Lufilian fold and thrust belt during and after peak metamorphism and that mineralizing fluids responsible for the formation of many of these deposits, including Kansanshi, may have been metamorphic in origin.