Re-Os systematics of löllingite and arsenopyrite in granulite facies garnet rocks: Insights into the thermal evolution of the Broken Hill block during the Early Mesoproterozoic

N.J. SAINTILAN[1]*, R.A. CREASER[1], P. G. SPRY[2]

[1]Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Canada (*correspondence: saintila@ualberta.ca, rcreaser@ualberta.ca)

[2]Iowa State University, Ames, IO, USA (pgspry@iastate.edu)

Löllingite and euhedral arsenopyrite crystals are reported from granulite facies spessartine-almandine garnet rocks closely associated with the Pb- and Zn-sulfide orebodies at the Broken Hill deposit, Southern Curnamona Province (SCP), New South Wales, Australia [1,2]. Sulfide minerals comprise löllingite and coexisting arsenopyrite ± galena ± tetrahedrite interestitial to garnet crystals. Löllingite formed first whereas gold-bearing löllingite, now occurring as relicts in arsenopyrite, was destroyed to produce arsenopyrite ± gold microinclusions.

Standard mineral separation procedures produced pure separates of löllingite, arsenopyrite and arsenopyrite ± löllingite. Re-Os data of these mineral fractions show a very narrow range of $^{187}Re/^{188}Os$ (7 to 11) and $^{187}Os/^{188}Os$ ratios (0.8505 to 0.9650) but in $^{187}Os/^{188}Os$ vs. $^{187}Re/^{188}Os$ space define a Model 1 isochron (n = 14) with an age of 1534 ± 33 Ma (2σ; MSWD = 0.78, initial $^{187}Os/^{188}Os$ ratio of 0.672 ± 0.005). Os and Re contents are extremely high for all sulfide phases (Re = 120–475 ppb; Os = 65–345 ppb) likely as a result of concentration of Re and Os in these minerals during granulite facies metamorphism, from the inferred exhalite protolith.

In the polydeformational and polymetamorphic history of the granulite facies rocks of the SCP, monazite grew from lower amphibolite facies at ca. 1657 Ma to granulite facies at ca. 1602 Ma [3]. The current age of sulfide mineralization implies a cooling rate of 3 to 4°C/Ma in the SCP from ca. 780°C (monazite precipitation) to ca. <550°C and formation of arsenopyrite from the destruction of gold-bearing löllingite during late retrograde metamorphism [3, this study].

[1] Spry, P.G., Wonder, J.D. (1989) *Can Miner* **27**, 275-292.

[2] Plimmer, I.R. (2006) *Miner Petro* **88**, 443-478

[3]McFarlane, C.R.M., and Frost, B.R., (2009) *J Metamorphic Geol* **27**, 3-17