Preliminary Re-Os dating of the Mount Isa Copper Ores, NW Queensland

M.J. GREGORY, R.R. KEAYS, A.R. WILDE
AND B.F. SCHAEFER

*pmd**CRC, School of Geosciences, Monash University,
Clayton, Victoria, Australia
(Bruce.Schaefer@sci.monash.edu.au)

Preliminary Re-Os isotopic analyses of whole rocks and sulphide separates from the Mount Isa copper and lead-zinc orebodies define an imprecise Re-Os isochron age of 1370 ± 80 Ma and initial ^{187}Os/^{188}Os ratio of 0.20 ± 0.25 (MSWD = 49). Two of these samples were also dated using the K-Ar system giving ages of 1356 ± 27 Ma and 1134 ± 22 Ma.

The new data imply that copper ore formation was much younger than the 1523 to 1505 Ma range inferred using ^{40}Ar/^{39}Ar dating of biotite presumed but not proven to be of hydrothermal origin (Perkins et al., 1999). Previously published Rb-Sr analyses of hydrothermally-altered tuff samples from the orebodies collectively define an isochron age of 1323 ± 12 Ma (Farquharson and Richards, 1975; Page 1978). The initial ^{87}Sr/^{86}Sr of 0.7418 ± 0.0061 is very radiogenic and is consistent with an hydrothermal resetting event at this time. There are several mica ^{40}Ar/^{39}Ar ages in the range 1440 Ma to 1325 Ma (Spikings et al. 2002; Perkins et al. (1999). These are variously interpreted as due to fluid flow unrelated to copper formation (Perkins et al., 1999) or cooling and uplift (Spikings et al., 2002).

We stress that the Re-Os data are preliminary and additional analyses are in progress. Our data, however, suggest that copper ore formation at Mount Isa occurred much later than previously supposed and there is some support for this from other isotopic systems. If the ^{40}Ar/^{39}Ar mica ages are a reflection of a discrete hydrothermal event then the cooling from peak metamorphism was not as protracted as previously supposed.

References

Farquharson R.B., and Richards J.R., (1975), *Chem. Geol.* 16, 73-88.

Page R. W., (1978), *J. Geol. Soc. Aus.*, 25, 141-163.

Perkins C., Heinrich C.A. and Wyborn L., 1999, *Econ. Geol.* 94, 23-36.

Spikings R.A., Foster D.A., Kohn B.P., and Lister G.S., (2002), *Precamb. Res*. 109, 103-144.

Atmospheric evolution and metallogenesis: Cycling of redox-sensitive metals

JUDITH L. HANNAH[1], HOLLY J. STEIN[1]
AND ANDREY BEKKER[2]

[1]AIRIE Program, Department of Geosciences, Colorado State University, Fort Collins, CO 80523-1482, USA
(jhannah@cnr.colostate.edu, hstein@cnr.colostate.edu)
[2]Geophysical Laboratory, Carnegie Institute of Washington, 5251 Broad Branch Road, NW, Washington, DC 20015
USA (a.bekker@gl.ciw.edu)

Re-Os geochemistry of black shales offers a glimpse into the evolution of the earth's atmosphere and its influence on the cycling of redox-sensitive metals. Weathering processes control the distribution of these elements in the earth's crust and their availability for ore-forming processes during crustal metamorphic-magmatic events. Re, Os, Mo and other redox-sensitive metals are soluble under oxidizing conditions, but fixed by reducing agents, especially organic matter and sulphides. Thus, sulphidic and/or organic shales represent a major reservoir for these elements in the crust.

Modern seawater, with ^{187}Os/^{188}Os approaching 1, derives dissolved Os largely from oxidative weathering of exposed crust. Organic shales are by far the dominant Re and Os contributor. Shales, in turn, acquire the bulk of their Re and Os from dissolved species in seawater. Assuming the Archean atmopshere was anoxic, we predict that Archean shales have lower concentrations of these metals, as the lack of oxidative weathering would greatly inhibit transfer of dissolved Re and Os from the continents to the oceans. Moreover, Archean shales should have ^{187}Os/^{188}Os ratios near chondrite (presently 0.127), reflecting a predominantly hydrothermal source.

Re and Os concentrations in pyrite from the 2.6 Ga Roy Hill shale, Jeerinah Formation, Hammersley Basin, Western Australia, range from 0.5 to 7.5 ppb, and 16 to 227 ppt, respectively. In contrast, Re and Os concentrations in pyrite from the 2.3 Ga Timeball Hill/Rooihoogte shales, Transvaal Basin, South Africa, range from 17 to 50 ppb and 700 to 3000 ppt. The undisturbed Transvaal section yields an excellent isochron age of 2316±7 Ma. Initial ^{187}Os/^{188}Os ratios are near chondritic even in the Paleoproterozoic. This indicates that riverine flux of radiogenic Os from the continents to the oceans lags the rise of atmospheric oxygen because of the low concentrations in Archean shales – the predominant source of continental Os. Together, these data suggest that black shale was a less important reservoir of redox-sensitive elements in the Archean.