Re-Os and highly siderophile element systematics of Archean komatiites from Kambalda (W-Australia)

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The Kambalda komatiites are part of the 2.7 Ga late Archean greenstone belt in Western Australia. They host magmatic sulphide ore deposits. High degrees of partial melting and a comparatively low S content in the komatiite mantle source suggest that the initial melts were likely sulphur-undersaturated. Thus, in order to explain the formation of sulphide depositis it has been proposed that the komatiites may have reached sulphur saturation by assimilation of sediments [1]. This scenario, however, was difficult to reconcile with Re-Os and S isotope data that did not provide evidence for assimilation of crustal components or sediments [2,3]. In order to place further constraints on the origin of Kambalda komatiites and sulphide ores, we determined osmium ($^{187}Os/^{188}Os$) isotope compositions and concentrations of highly siderophile elements (HSE) for a suite of 11 komatiites.

Concentrations of compatible HSE (Os, Ir, Ru) decrease with decreasing MgO and Ni, whereas incompatible HSEs (Pd, Au, Re) show no systematic variation with MgO or other indicators for fractional crystallization. The measured $^{187}Os/^{188}Os$ compositions of the Kamabalda komatiites range from 0.1114 to 0.6568, with $^{187}Re/^{188}Os$ between 0.092 and 11.84. The $^{187}Os/^{188}Os$ compositions obtained for 3 of the studied samples are significantly more radiogenic compared to values reported in [2]. In a Re-Os isochron diagram our samples plot along a previously presented isochron, defined by sulphide ores and one bulk komatiite, yielding an age of 2706 ± 36 Ma and a chondritic $^{187}Os/^{188}Os$ composition with γOs of –0.10±0.32 [2]. Using this age as crystallization age, the initial Os isotope compositions of the komatiites range from 0.0575 to 0.1110, translating into significant deviations from the chondritic trajectory at the time of emplacement (γOs from +2.4 to –50). The radiogenic $^{187}Os/^{188}Os$ and high Re/Os obtained for some komatiites in this study are best explained by assimilation of crustal material and may therfore point towards a crustal origin of sulphur in the Kambalda ores.

[1] Huppert *et al*. (1984) Nature **309**, 19-22. [2] Foster *et al*. (1996) Nature **382**, 703-706. [3] Bekker *et al*. (2009) Science **326**, 1086-1089.