Revisiting the age of the Merensky Reef, Bushveld Complex

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The giant Paleoproterozoic Bushveld Complex in the Kaapvaal craton of South Africa may have been emplaced and crystallized in a relatively short period of time [1], perhaps as little as a few million years, followed by rapid cooling [2]. Determination of the absolute duration of Bushveld-related magmatism requires careful application of the single-grain chemical abrasion ID-TIMS, or CA-TIMS, U-Pb zircon method. We recently reported a CA-TIMS zircon age for a sample of the PGE-rich Merensky Reef (West Mine, Rustenburg Section) in the Western Limb of the Bushveld Complex with a weighted mean $^{207}Pb/^{206}Pb$ age of 2054.4 ± 1.3 Ma (2σ, decay constant errors not included, n = 6) [3]. Use of the EARTHTIME ^{205}Pb-^{233}U-^{235}U tracer and synthetic U/Pb standard solutions now allow for assessing intra- and inter-laboratory reproducibility. We provide a new U-Pb age for zircon from a sample of the Merensky Reef in the Eastern Limb of the complex (Farm Driekop), 2055.30 ± 0.61 Ma (MSWD = 0.43, n= 10), and a revised age based on new analyses for our sample of the reef from the Western Limb, 2056.13 ± 0.70 Ma (MSWD = 0.44, n = 8). All ages were Th-corrected using Th/U = 3, characteristic of the B-1 and B-2 marginal rocks related to the Upper Critical Zone [4]. Compiled results for analyses of the 2000 Ma EarthTime standard solution are 1999.75 ± 0.47 Ma (MSWD = 0.42, n = 18). Analyses conducted at Wyoming by CA-TIMS, with EARTHTIME tracer and standard solutions, on zircon from the Western Limb sample yield a preliminary age of 2056.1 ± 1.1 Ma (MSWD = 0.096, n = 6). This interlaboratory comparison reveals that the crystallization age of the Rustenburg Merensky Reef sample is slightly older than the age reported in [3], although within analytical uncertainty. These results demonstrate the contemporaneity of these Merensky Reef samples, separated by ~300 km, and the potential for distinguishing magmatic events within the Bushveld Complex different in age by 1-2 million years.

[1] Cawthorn & Walraven (1998) *J. Petrol.* **39**, 1669–1687. [2] Nomade *et al.* (2004) *J. Geol. Soc. London* **161**, 411–420. [3] Scoates & Friedman (2008) *Econ. Geol.* **103**, 465–471. [4] Barnes *et al.* (2010) *Econ. Geol.* **105**, 1491–1511.

Tracking Archean seawater trace metal inventories through multi-proxy analysis of euxinic black shales

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Seawater concentrations of biologically significant and redox-sensitive trace metals have varied through time, reflecting intimate coupling of geological and biological processes in the Earth System. Euxinic black shales, organic carbon-rich mud rocks deposited beneath sulfidic bottom waters, are commonly enriched in such trace metals. Recent work focusing on Mo enrichments have demonstrated the potential to use geochemical analyses of euxinic black shales to track temporal trends in the concentrations of other trace metals in seawater [1].

Multiple episodes of euxinic deposition have recently been identified in the Archean [2-4]. In this study we compare the enrichments of a suite of biologically relevant trace metals (Fe, Mo, Cu and Zn) from Archean euxinic black shales in order to identify temporal trends in their relative abundance in seawater. To strengthen our arguments for faithful preservation of seawater chemistry and to facilitate comparison between Archean shales, as well as comparisons to euxinic shales deposited throughout Earth history, we present our study in the context of additional redox proxies, including TOC, Fe speciation, multiple S isotope analyses and Re-Os systematics.

[1] Scott *et al.* (2008) *Nature* **452**, 456–459. [2] Reinhard *et al.* (2010) *Science* **326**, 713–716. [3] Kendall *et al.* (2010) *Nature Geoscience* **3**, 647–652. [4] Scott *et al.* (2011) *Geology* **39**, 119–132.