Mafic dykes of the southeastern Gawler Craton: *ca* 1564 Ma magmatism with an enriched mantle source

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SUPPLEMENTAL DATA

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Supplemental data

Appendix 2. Details of analytical methods
The data supporting the findings of this study are available on Mendeley at https://doi.org/10.17632/hrjr6d542v.1.

Appendix 2. Details of analytical methods

Zircon geochronology samples were processed at MinSep Laboratories, Denmark, Western Australia by standard crushing, density, and magnetic methods. Zircons extracted from the samples were mounted in epoxy resin together with the Temora 2 U–Pb standard and U concentration standard BR266 (903 ppm), and polished to expose the grain interiors. The zircons were imaged under plain transmitted and reflected light and with cathodoluminescence (CL) to reveal their internal structures. Isotopic analyses were undertaken using both sensitive high-resolution ion microprobe (SHRIMP) and laser ablation-inductively coupled plasma mass spectrometry (LA-ICPMS).

SHIRMP analyses were performed using SHRIMP IIe at Geoscience Australia in Canberra using a 10 kV primary O^{2-} beam, initially of 3.5 nA intensity, focused through a 100 µm aperture to form a 20 µm diameter spot. Later in the session a smaller of 70 µm aperture producing a 10 µm diameter spot was used to target the smaller cores within the zircon grains, and beam intensity consequently reduced to 1.2 nA. Secondary ions were collected on an electron multiplier via cycling of the magnet through 5 scans across the mass range of interest. Established SHRIMP operating procedures and data reduction schemes were used (Williams, 1998). Mass resolution was >4900. Differential fractionation between U and Pb is corrected by reference to a $^{206}Pb/^{238}U$ ratio of 0.0668 for interspersed analyses of the Temora 2 zircon standard (416.8 ± 0.3 Ma; Black *et al.,* 2004). The calibration error for the first batch of analyses (100 µm aperture) was 0.22% (1σ) and for the second batch (70 mm aperture), 0.3% (1 σ). The external spot-to-spot error assigned to $^{206}Pb/^{238}U$ for the whole session was 1.0 % (1σ). Temora 2 was also used to monitor isobaric interference at the ^{204}Pb mass peak. The OG1 reference zircon ($^{207}Pb/^{206}Pb$ = 0.29907 ± 0.00011, corresponding to an age of 3465.4 ± 0.6 Ma; Stern *et al.,* 2009) was used to monitor $^{207}Pb/^{206}Pb$ reproducibility and accuracy, and produced an age of 3464.8 ± 2.3 Ma for the session (MSWD = 1.3). Correction for non-radiogenic Pb in zircon was based on the measured $^{204}Pb/^{206}Pb$ and a contemporaneous Pb isotope composition determined according to Stacey and Kramers (1975), and pooled $^{207}Pb/^{206}Pb$ ages have been corrected for Instrumental Mass Fractionation following the method outlined in (Stern *et al.,* 2009). Squid-2 software was used for data reduction (Ludwig, 2009).

LA-ICPMS analysis was undertaken at Adelaide Microscopy, University of Adelaide, in December 2013 and utilised a New Wave 213 nm Nd–YAG laser with a 30 µm spot size coupled to an Agilent 7500 quadrupole ICPMS. Analytical protocols were identical to those described by Howard *et al.* (2011a) and Howard *et al.* (2011b). Time-resolved signals of $^{204, 206, 207, 208}Pb$, ^{232}Th and ^{238}U were acquired with a 5 Hz repetition rate and processed using GLITTER software (Griffin *et al.,* 2008). The GJ-1 standard zircon (Jackson *et al.,* 2004) was used to calibrate U and Pb fractionation and data quality was monitored by analysing zircon standards QGNG (1851.6 ± 0.6 Ma; Black *et al.*, 2003) and Plešovice (337.13 ± 0.37 Ma; Sláma *et al.*, 2007). Weighted mean ages for these standards during the course of the analysis of sample 1893814 were 1840 ± 22 Ma ($^{207}Pb/^{206}Pb$ age, n = 4, MSWD = 0.74) and 342 ± 13 Ma ($^{206}Pb/^{238}U$ age n = 4; MSWD = 2.7), respectively. The LA-ICPMS data for ^{204}Pb are compromised by interference from ^{204}Hg, a trace contaminant in the Ar–He carrier gas and by the low detection levels; nevertheless, ^{204}Pb was monitored to give an indication of zircons that may contain elevated non-radiogenic Pb. No correction for non-radiogenic Pb has been applied to the LA-ICPMS data; in all but four analyses ^{204}Pb remained at background values.

Age calculations for both SHRIMP data were made using Isoplot/Ex (Ludwig, 2003) and for the LA-ICPMS data, IsoplotR (Vermeesch, 2018). Isotopic ratios and single ages are cited at ±1σ, whereas weighted mean $^{207}Pb/^{206}Pb$ ages are given at 95% confidence limits.

Whole-rock samples of mafic dyke were analysed for multi-element geochemistry at a commercial laboratory, ALS, Perth (http://www.alsglobal.com/minerals.aspx). Pulverised samples were analysed for major, trace, and rare earth elements by lithium metaborate fusion followed by dissolution in 100 mL of 4% HNO_3/2% HCl solution. This solution was then analysed by ICP-MS methods.

The Sm–Nd isotopic compositions of whole-rock samples was determined at the University of Adelaide using methods identical to those reported by Wade *et al.* (2005). Sm and Nd were isolated from whole rock powder via acid digest and heating in sealed teflon bombs for four days. The Sm and

Nd isolate was then spiked with a ^{150}Nd–^{149}Sm solution and analysed via thermal ionisation mass spectrometry on a Finnigan MAT 262 mass spectrometer. Measurement of the La Jolla reference material during the course of these analyses yielded a $^{143}Nd/^{144}Nd$ value of 0.512098.

The data are available on Mendeley at https://doi.org/10.17632/hrjr6d542v.1.

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