Detrital Zircon Geochronology of Sedimentary Rocks of the 3.6 – 3.2 Ga Barberton Greenstone Belt: No evidence for older continental crust

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The setting of Archean greenstone belts, whether formed on or adjacent to older continental blocks or whether they originated in juvenile settings with only small, local enclaves of more fractionated rocks, remains a major issue in Archean geology. This controvercy is well illustrated by the Paleoarchean 3.55 to 3.20 Ga Barberton greenstone belt (BGB) of southern Africa, whose crustal setting has been debated for several decades. Here we report detrital zircon U-Pb age data of sandstones from the Onverwacht, Fig Tree and Moodies Groups as well as meteorite impact-related tsunami deposits. The LA-ICP-MS and SHRIMP-RG analyses of zircons reveal age clusters at 3.54, 3.46, 3.40, 3.30 and 3.25 Ga, which largely reflect the major episodes of felsic intrusive and extrusive magmatic activity within and in the vicinity of the belt. The presence of similar age clusters throughout the BGB indicate that the sediments were either sourced from the same magmatic centers or that magmatic events of similar ages occurred widely around the BGB.

The collective studies of 3410 detrital zircon grains from BGB sandstones revealed only 15 grains (<0.5%) of pre-BGB age, with the oldest grain at 3,811 ± 14 Ma. Had any old, evolved continental crust underlain or been present in the hinterland to the BGB, late-stage uplift would have exposed those rocks to erosion and detrital zircons representing this crust should be present in upper BGB sedimentary units. The scarcity of zircons older than the BGB thus argues strongly that the BGB was not developed on older continental crust but formed in a less differentiated and more juvenile terrane with only local occurrences of fractionated rocks. 10 of the old zircons were extracted from a tsunami deposit associated with the S6 impact and may have been derived from far beyond the BGB by impact-related processes. The remaining old zircons could represent felsic rocks in older, unexposed parts of the BGB sequence, but are too few to provide evidence for a continental source.