

Nature and timing of Late Archaean arc magmatism along the western margin of the Yilgarn Craton

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The presence of two Late Archaean low-grade greenstone belts in generally high-grade rocks at the western margin of the Western Gneiss Terrain raises significant questions concerning the evolution of the Yilgarn Craton, since the nearest comparable greenstones occur >400 km. The location of these greenschist facies rocks at Mt Saddleback (Boddington) and Morangup Hill (Toodyay), in close proximity to the Darling Fault, refutes earlier views that the craton was either tilted to the east, thus exposing older cratonic 'roots' in the west, or that there was a progressive eastward accretion of terranes.

We report results from a re-investigation of the two belts, with SHRIMP U-Pb zircon dating of felsic lavas and tuffaceous rocks from the Saddleback greenstone belt defining a narrow period of eruption between 2675 and 2665 Ma, with granite emplacement at 2663 ± 3 Ma. This constrains deformation and metamorphism of the belt to the small time-window between the onset of volcanism and magmatic intrusion. Importantly, these ages overlap the emplacement of the Coates Siding gabbro (2664 ± 6 Ma), interpreted as a mafic sill associated with the Morangup greenstone belt, 160 km to the north. The SHRIMP results establish not only the Late Archaean age of the Saddleback and Morangup greenstone belts but also the coeval nature of mafic/felsic volcanism and plutonic activity.

Geochemical whole rock data indicate that both greenstone belts have signatures consistent with an island arc of intermediate maturity. The lack of inherited zircons in the volcanics and gabbro implies that they formed away from pre-existing crust. However, the presence of 3.2 and 2.8 Ga zircon xenocrysts in the granite at Mt Saddleback suggest emplacement through continental crust.

It appears likely, from seismic data, that the arc was transported westward and accreted to older crust of the Western Gneiss Terrain by ~ 2663 Ma. Subsequent crustal addition was also from the east, but the high-grade metamorphism here (Lake Grace Terrane) at ~ 2640 Ma indicates that this portion of the Yilgarn Craton must have amalgamated at a somewhat later time. Furthermore, the similarity in age of greenstone volcanism along the western margin to that in the Eastern Goldfields region of the eastern Yilgarn Craton (~ 2670 Ma) suggests that the craton did not amalgamate by progressive eastward accretion of arcs; instead, discrete crustal blocks formed and were swept together after ~ 2640 Ma to form the amalgamated Yilgarn Craton.