THE MESOPROTEROZOIC TRANSITION IN AUSTRALIA: ARCS, PLUMES, AND CONTINENTAL BREAK-UP?

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Tectonic models for the latest Palaeo-proterozoic to earliest Mesoproterozoic evolution of the eastern Australia (ca 1620-1500 Ma) are diverse and either emphasize plume or plate margin activity, neither of which satisfactorily explain all geological observations. The dichotomy is largely attributed to geochemical, and spatial and temporal data that suggest voluminous A-type felsic magmas are plume-related, whereas the distribution of arc-related magmas and intense orogenic overprint suggest plate margin activity. The salient geological events include arc-related magmatism at ca ca 1620-1610 Ma followed by a magmatic hiatus coincident with north-south crustal shortening at ca 1610-1590 Ma and a magmatic flare-up of A-type felsic magmas throughout the Gawler Craton at ca 1595-1575 Ma. Resumption of arc magmatism occurred along the northern margin of the Gawler Craton at ca 1590-1550 Ma and there was a 90° shift in the regional shortening direction throughout eastern Australia. Arc(?) magmatism occurred in the Georgetown Inlier at ca 1550 Ma. To satisfy all available temporal and geological data we suggest a complex tectonic environment involving two plate margins. We propose a tectonic model in which a north-dipping subduction zone rolled back over a plume head at ca 1610 Ma. Flat subduction caused transient orogenesis (1610-1595 Ma) in the overriding plate, resulting in the development of the Gawler orocline. Slab windowing and thermal assimilation of the plume and the subducting slab caused extensive mantle-derived and crustal melting in the Gawler Craton (1595-1575 Ma). This marks the beginning of a northward younging continental hotspot track defined by A-type magmatism emplaced between ca 1595 and 1500 Ma. The hotspot track formed during this event is used as a proxy to determine Australia's position relative to Laurentia in the absence of paleomagnetic data. The hotspot track suggests that Australia drifts to higher latitudes by 1500 Ma, whereas Laurentia at 1475 Ma remains at low latitudes. This suggests that Australia and Laurentia rifted apart between ca 1540 Ma and 1500 Ma and the hotspot track may define part of Australia's transition from a modified SWEAT configuration with Laurentia to a paleomagnetic reconstruction where are Australia and Laurentia were disconnected at ca 1200 Ma. Australia's position in Rodinia therefore requires reconsideration.