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Consequences of 'hot orogenesis' for Cretaceous breakup of East Gondwana's active margin: Perspectives from West Antarctica

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Australia's Tasman Orogen provides a type locality for 'hot orogens,' equated to tectonic cycles of intense convergence, HTLP metamorphism, magmatism and rapid extensional collapse during Paleozoic time, affecting Lachlan Belt turbidites that formed a sector of the East Gondwana margin. This paper presents evidence that the Late Devonian - Early Carboniferous cycle was not limited to Australia, but affected correlative greenschist-facies turbidite units within Antarctica and New Zealand, which were contiguous along the active margin. Petrological, geochronological (U-Pb SHRIMP zircon and in-situ EMP monazite) and geochemical data from the Fosdick Mountains gneiss dome in Antarctica indicate that high temperature metamorphism ($T>800°C$) of turbidite source rocks at 375 to 350 Ma generated substantial granite melt within discrete complexes, possibly localized upon wrench structures. There were not widespread regional effects. Post-tectonic peraluminous magmatism occurred in the Early Carboniferous, an indication of sustained high temperatures and melting of turbiditic source rocks in the middle crust; and there is sparse but growing evidence for development of a successor basin by Permian time.

Tectonic associations in Antarctica and New Zealand show that Lachlan-style orogenesis did not cease in the Paleozoic but recurred in Mesozoic time. On the tectonic

reconstruction of the Gondwana margin, gneiss domes, core complexes, and granites of 115 to 96 Ma define a high temperature metamorphic belt that flanks the broad Cretaceous extensional province represented by the West Antarctic rift system and Tasman Sea basin. Peak temperatures in excess of 800°C again affected the Fosdick Mountains dome, determined from mineral equilibria modeling of metasedimentary migmatites and recorded by growth of metamorphic and igneous zircon in migmatites. Pervasive melting is documented by microstructures and by the presence of granitic leucosome in structural sites including shear bands, fold hinge zones, and interboudin necks. Outcrop-scale linkages between melt source and transfer zone are substantiated by geochemical data and by U-Pb SHRIMP zircon ages for leucosome of circa 107 Ma, acquired from metamorphic rims upon inherited grains within host gneiss and also from euhedral igneous grains from discordant shear bands. Leucogranite as young as 102.4 ś 0.7 Ma (U-Pb SHRIMP / igneous zircon) intruded the dextral transtensional zone that bounds the Fosdick Mountains dome, and a detachment fault localized at or near the melt propagation front.

Relationships in the Fosdick Mountains and correlative structures in New Zealand are emblematic of the elevated crustal temperatures and melt-controlled deformation that led to development of the wide intracontinental rift province separating West Antarctica-New Zealand from East Antarctica-Australia in Cretaceous time. Unlike Paleozoic events in Australia that culminated with basin inversion and closure, the Mesozoic transtension to rift cycle was a terminal event upon the East Gondwana margin because plate reorganization followed.