

THE CHANGING RELATIONSHIP BETWEEN GONDWANA AND PERI-GONDWANA THROUGH TIME

J. Brendan Murphy¹; Sergei Pisarevsky²; R. Damian Nance³

¹Department of Earth Sciences, St. Francis Xavier University, P.O. Box 5000, Antigonish, NS B2G 2W5, Canada; ². School of Earth and Environment (M004), University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia; ³, Department of Geological Sciences, 316 Clippinger Laboratories, Ohio University, Athens, Ohio 45701, U.S.A.

ABSTRACT: The Neoproterozoic-Early Cambrian evolution of peri-Gondwanan terranes (e.g. Avalonia, Carolinia, Cadomia) along the northern (Amazonia, West Africa) margin of Gondwana provides insights into the amalgamation of West Gondwana. The main phase of tectonothermal activity occurred between ca. 640-540 Ma and produced voluminous arc-related igneous and sedimentary successions related to subduction beneath the northern Gondwanan margin. Subduction was not terminated by continental collision so that these terranes continued to face an open ocean into the Cambrian.

Prior to the main phase, Sm-Nd isotopic studies suggest that the basement of Avalonia, Carolinia and part of Cadomia was juvenile lithosphere generated between 0.8 and 1.1 Ga within the peri-Rodinian (Mirovoi) ocean. Vestiges of primitive 760-670 Ma arcs developed upon this lithosphere are preserved. Juvenile lithosphere generated between 0.8 and 1.1 Ga also underlies arcs formed in the Brazilide Ocean between the converging Congo/São Francisco and West Africa/Amazonia cratons (e.g. the Tocantins province of Brazil). Together, these oceanic arc assemblages with similar isotopic characteristics may reflect subduction in the Mirovoi and Brazilide oceans as a compensation for the breakup of Rodinia and the generation of the Paleopacific. Unlike the peri-Gondwanan terranes, however, arc magmatism in the Brazilide Ocean was terminated by continent-continent collisions and the resulting orogens became located within the interior of an amalgamated West Gondwana.

Accretion of juvenile peri-Gondwanan terranes to the northern Gondwanan margin occurred in a piecemeal fashion between 650 and 600 Ma, after which subduction stepped outboard to produce the relatively mature and voluminous main arc phase along the periphery of West Gondwana. This accretionary event may be a far-field response to the breakup of Rodinia. The geodynamic relationship between the closure of the Brazilide Ocean, the collision between the Congo/São Francisco and Amazonia/West Africa cratons, and the tectonic evolution of the peri-Gondwanan terranes may be broadly analogous to the Mesozoic-Cenozoic closure of the Tethys Ocean, the collision between India and Asia beginning at ca. 50 Ma, and the tectonic evolution of the western Pacific Ocean.

Several peri-Gondwanan terranes drifted away from Gondwana in the Late Cambrian-Early Ordovician, resulting in the birth of the Rheic Ocean. These terranes became incorporated into the Paleozoic Appalachian, Caledonide and Variscan orogens in an orogenic cycle that culminated with the formation of Pangea. Thus, the evolution of the peri-Gondwanan terranes records processes associated with the breakup of Rodinia, as well as the amalgamation of Gondwana and Pangea.

Keywords: peri-Gondwana, West Gondwana, juvenile lithosphere