
Highly depleted oceanic lithosphere in the Rheic Ocean: implications for Paleozoic plate reconstructions

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The Rheic Ocean formed at ca. 500 Ma when some peri-Gondwanan terranes (e.g., Avalonia, Carolina) drifted from the northern margin of Gondwana, and was consumed during the Late Carboniferous collision between Laurussia and Gondwana, a key event in the formation of Pangea. Several mafic complexes ranging from ca. 400–330 Ma preserve many of the lithotectonic and/or chemical characteristics of ophiolites. They are characterized by anomalously high ϵNd values that are typically either between or above the widely accepted model depleted mantle curves. These data indicate derivation from a highly depleted (HD) mantle and imply that (i) the mantle

source of these complexes displays time-integrated depletion in Nd relative to Sm, and (ii) depletion is the result of an earlier melting event in the mantle from which basalt was extracted.

The extent of mantle depletion indicates that this melting event occurred in the Neoproterozoic, possibly up to 500 million years before the Rheic Ocean formed. If so, the mantle lithosphere that gave rise to the Rheic Ocean mafic complexes must have been captured from an adjacent, older oceanic tract. The transfer of this captured lithosphere to the upper plate enabled it to become preferentially preserved. Possible Mesozoic-Cenozoic analogues include the capture of the Caribbean plate or the Scotia plate from the Pacific to the Atlantic oceanic realm. This model implies that virtually all of the oceanic lithosphere generated during the opening phase of the Rheic Ocean was consumed by subduction during Laurentia-Gondwana convergence.