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Tectonic and sedimentological transitions at the northwestern periphery of Rodinia balance the global plate kinematic budget during supercontinent breakup

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Transitions in the sedimentary environments and the convergent plate margin dynamics around the periphery of Neoproterozoic supercontinent Rodinia should have been developed during the breakup of the core of Rodinia in order to balance the global plate kinematic budget. Recent paleomagnetically, kinematically, and geologically self-consistent reconstructions place South China and Madagascar, together with India and the Seychelles, positioned on the northwestern peripheral subduction girdle of Rodinia. Here we report 740–720 Ma, low-$\delta^{18}O$ and high-$\delta^{30}Si$ rhyolites from northern South China, both indicating high-temperature hydrothermally altered seawater contributing to the source compositions. Proposed rapid strike-slip tectonic motion along the periphery of Rodinia at this same time[1] may account for such hydrothermal involvement in subduction girdle magmatism as it implies an extensive ridge-transform fault, not unlike the current back arc systems of the West Pacific along the periphery of megacontinent Eurasia today. This high-$\delta^{30}Si$ signature of rhyolites inherited from seawater is consistent with the sedimentary environment transitioning from terrestrial to marine after ca. 750 Ma in the northern Yangtze basin[2]. Also, a compilation of published data of felsic rocks from the Bemarivo terrane of northern Madagascar[3] demonstrate a ca. 740–720 Ma tectonic transition from an intraplate to a subduction setting, as indicated by a zircon Hf isotopic shift from enriched to depleted, a shift from low-$\delta^{18}O$ to mantle-like $\delta^{18}O$ signatures, and a change from A-type (extension) to Cordilleran-type (compression) magmatism. These distinctive geochemical features indicate subduction initiation in the Bemarivo terrane between 740 and 720 Ma, likely representing the balance of the global plate kinematic budget during Rodinia breakup. If this is correct, our study provides a new type of peripheral constraint on the breakup timing of the core, however distant, of Rodinia. This work also suggests a spatially linked geodynamic system between South China and Madagascar akin to the Cordillera of Pangea breakup.

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