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Sr and Nd isotopes in metacarbonate rocks as proxies for paleo-tectonic reconstruction prior to supercontinent assembly

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Chemically precipitated carbonate sediments directly record seawater composition that helps us to decode the Earths paleo-environment, existence of paleo-oceans and provide valuable clues on paleo-tectonic position of continents in the Earths history. In addition, the geochemical and isotopic composition of carbonate rocks also have a strong dependence on the depositional tectonic setting and surrounding source rock composition especially in the Precambrian era, during which biological activity were less prominent and vegetation was virtually absent. Here we present evidence for the existence of an Oceanic Island arc system and peripheral Oceans before the formation of Gondwana supercontinent in the Neoproterozoic. Applying a multi-element isotope geochemical approach on chemostratigraphically well-constrained metacarbonate rocks collected from several supracrustal terrains in Gondwana, including the remote Sor Rondane Mountains in East Antarctica, we model carbonate deposition surrounding an island arc system, mid-ocean volcanic islands and shallow marine continental shelf of a yet unidentified interior Antarctic continent, all of which accreted and amalgamated in the late Neoproterozoic to early Paleozoic to form the Gondwana supercontinent.

We also compare the metacarbonate data with basement rocks from various neighboring Gondwana continents, wherein some regional affinities could be established. Nd model ages of cratonic basements from East Africa (Kalahari) and India (Dharwar) is obviously different from Balchen carbonate rocks from Sor Rondane in East Antarctica, and the possible existence of a cratonic nucleus within the East Antractic continent is speculated, surrounding which the carbonate rocks of the Balchen region might have deposited. Thus, the Sr and Nd isotopic compositions provide important information about depositional setting of sedimentary rocks and relationship with surrounding basement and continents. Geochemical proxies, such as Nd and Sr isotopes of metacarbonate rocks, can yield key information not only of paleo-oceans but also about the surrounding rocks of oceanic crust (basement) and continental crust during the time of deposition, which can lead us to a better understanding of paleo-tectonic setting of crustal fragments that assemble to form supercontinents.

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