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The potential climatic impacts of Ediacaran tectonics.

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The end of the Proterozoic era is marked by some of the most dramatic events in Earth's history, with this period of time being characterised by extensive changes in seawater chemistry demonstrated through the strontium, sulphur and carbon isotope records, large climatic extremes, and preservation of the Ediacaran faunal assemblage and the explosion of Cambrian fauna. These global variations are concurrent with the amalgamation of Gondwana, and the closure of the Mozambique Ocean; representing one of the major and final Gondwana forming collisional zones. Solid-Earth processes associated with collisional zones, such as subduction, lithospheric thickening and exhumation, have a direct effect on the atmosphere and oceans through changes in weathering fluxes, oceanic circulation patterns, volcanic degassing rates, water mass distribution and planetary albedo. With the recent innovation of full-plate topological modelling for the Neoproterozoic, it can be used, in conjunction with geological data, to help decipher the relationship and interplay between tectonic processes and climatic variation during this enigmatic period in Earth's history.

Here we use geological constraints from the terranes of northern Africa and the Arabian-Nubian Shield to construct a regional full-plate model of the Arabian-Nubian Shield. This model is integrated into an existing global full-plate model of the Neoproterozoic, and highlights the defined changes in subduction zone kinematics preserved in the geology of northern Africa and Arabia. In particular, we relate the change in the orientation of subduction from (striking relative to present day Africa) east-west in the Cryogenian to north-south in the Ediacaran to the change in motion as Neoproterozoic India migrates southwards. The reconfiguration of crustal blocks during the Neoproterozoic to higher latitudes along with the closure of the Mozambique Ocean (ca. 580–550 Ma) occurs concurrently with late Ediacaran glaciations, such as the Gaskiers (ca. 580 Ma). The timing of this southward migration of crustal blocks, the redistribution of water masses along with the effects of the opening and closing of some oceanic gateways through tectonic events, may be a driver of major palaeoenvironmental change in the latest Ediacaran. Such a scenario is somewhat analogous to the role of gateway regions during the Cenozoic, when the opening of the Tasman Gateway and Drake Passage and closure of the Panama Gateway have been proposed to modulate ocean circulation and the onset of glaciation in polar regions. However, the relationship between climate and tectonics is a complex combination of indirect and direct effects between a variety of tectonic processes. The reconfiguration of crustal blocks, coupled with the closure of major ocean gateways, such as the Mozambique Ocean during the Neoproterozoic supports the previously proposed idea that late Ediacaran glaciations did not represent global glaciations, but rather a confined, tectonically driven glaciation.