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Destruction of the Mozambique Ocean: evidence from the Schirmacher Oasis, East Antarctica for accretion as a precursor to Gondwana assembly

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The Lurio–Vijayan block along with the adjoining crust of coastal central Dronning Maud Land, the Sor Rondane Mountains and the Yamato–Belgica Mountains, eastern Dronning Maud Land, has been interpreted as consisting of independent exotic blocks or arcs that formed between 800 and 600 Ma in response to accretionary orogensis during closure of the Mozambique Ocean. The Schirmacher Oasis, part of the Lurio–Vijayan block, comprises high-grade lithotectonic units that include felsic biotite-quartzofeldspathic gneiss (with two pyroxene granulite and sapphirine-orthopyroxene-garnet bearing granulite layers and pods) and enderbitic gneiss. These represent intermediate tonalitic magmatism, which, on a La-Y-Nb trace element plot have a calc-alkaline basalt affinity. The enderbitic gneiss contains enclaves of noritic gneiss and leucogabbro. Noritic gneiss-and foliated leucogabbro exposed in central Schirmacher further contain enclaves of metamafic and ultramafic rocks comprising melanocratic gabbro, gabbroic anorthosite and cumulate-textured pyroxenite and websterite, which preserve their pre-metamorphic (igneous) compositional layering despite a granulite-facies mineralogy. Interestingly, in contrast to their host rocks, these mafic enclaves have volcanic tholeiite or N-MORB affinity. Minor volumes of high-grade metasedimentary rocks include layered paragneiss comprising Fe-rich metapelite (quartz-garnet-sillimanite-perthite gneiss), garnet-sillimanite quartzite and minor calc gneiss all containing layers and boudins of metamorphosed noritic dykes. The 615 Ma and 648–658 Ma clusters in zircon U-Pb and garnet Sm-Nd dates from these granulites clearly represent the age range of the pervasive UHT granulite-facies event coeval with the East African Orogeny.

Detrital zircon age spectra do not contain older grains derived from continental interior domains, in contrast to the detrital zircon age spectra from the metasedimentary rocks of central Dronning Maud Land nunataks. They constrain the depositional ages of the sedimentary succession (now occurring as tectonic slices within granulite due to tectonic underplating), and can be interpreted in two ways: either the basin can be correlated with the chemostratigraphic depositional ages reported for carbonates from the Montepuetz Complex, Mozambique, and the reported depositional ages spanning c. 880 to 790 Ma for metacarbonate rocks from the Sor Rondane Mountains, that support the presence of contemporaneous marine platform depositional environment, probably in the now-consumed Mozambique Ocean; or, they represent Tonian basins being coeval and developed as a back-arc basin to the c. 1 Ga orthogneiss-dominated arc terrane of the central Dronning Maud Land.

We therefore propose a protracted multi-stage accretionary model of orogenesis involving collision and subduction of the paleo-Mozambique Oceanic lithosphere against the c. 1.1 Ga Mesoproterozoic central Dronning Maud Land arc crust being a precursor to Gondwana assembly from this crustal segment. We interpret the earliest mafic magmataism at c. 810 Ma to represent hydrous mafic underplate that interacted with the younger (c. 750 Ma) tonalitic melts at mid-crustal levels, as seen from field relations. The later high-temperature granulite-facies metamorphism at mid-crustal levels between 660 and 640

Ma suggests a) subduction related arc thickening and b) crustal thinning and initiation of back-arc basin due to slab break-off resulting in high-heat flow exposed to an asthenospheric source.