



Magmatism and Tectonics in the Meso-Archean Pongola Supergroup, South Africa

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The Pongola Supergroup is one of the most extensive and well preserved volcano-sedimentary successions emplaced in a continental setting in the Meso-Archean (c. 2.95 Ga). It contrasts with both the older (Barberton type c.3.5 Ga) and younger (Belingwe type c.2.7 Ga) greenstone belts in southern Africa in that the sequence has not undergone the strong horizontal compressional tectonics typically related to greenstone belt-TTG environments. However, it is appropriate to compare this sequence with rocks of the Barberton greenstone belt by which the final phase of deposition preceded that of the juxtaposed Pongola basin with a relatively small time interval. The Pongola succession, which commenced with the first major magmatic event after the Barberton greenstone belt, overlies granitoids and remnants of greenstone belts in SE South Africa and in SW Swaziland. Formation was not in a continental rift environment but most likely in a marginal epicontinental basin with syn-depositional subsidence in a half-graben fault system in the type area.

The Pongola rocks occur in two domains related to a NW-trending central basement high in the Kaapvaal Craton and achieving a maximum thickness of 8 km in the northern areas. The lower section (Nsuzze group 3.7 km thick) is made up mainly of lavas and pyroclastic rocks and the upper section (Mozaan Group 4.3 km thick) is arenaceous sediments and argillites with a thick volcanic unit observed in the south-eastern facies. Chemical affinities of the lavas include tholeiite and calc-alkaline over the compositional range of basalt to rhyolite. There is a preponderance of andesites in the compositional array. The preservation of these rocks gives insight into the range of volcanic processes that took place at this stage of Earth history and in some areas it is possible to identify eruptions from a single source over several kilometres, as well as feeder-dyke systems to the lava flows. Simultaneous eruption of contrasting magmas from several vents is a feature of this uniquely preserved magmatic record.

New precise zircon U-Pb ages give an indication that the entire basin formed in a remarkably short period of geological time between 2980 ± 10 Ma and 2954 ± 9 Ma, although complications arising from inherited zircons cannot be ruled out. While komatiites are not present in the Pongola a sequence of volcanoclastic rocks with well-preserved bombs of picrite composition and contained within a sandy matrix gives rise to a geochemical signature high in Cr and Ni which is the first evidence of an ultramafic component to this succession.

Evidence of rapid deposition, a preponderance of intermediate lavas, discordance of bounding (earlier) crustal blocks and consistent structural trends in the area, are similar to features found in continental arc basins currently observed in the south-western USA, and may present an alternative model to those currently accepted for Archean terranes in early-formed cratons.