SEDIMENTATION OF THE *GRAND CONGLOMERAT* (NEOPROTEROZOIC) AND IMPLICATIONS FOR RIFTING AND THE SNOWBALL EARTH MODEL IN CENTRAL AFRICA

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Keywords: Cryogenian, Grand Conglomerat, Lufilian Arc, Snowball Earth

The *Grand Conglomerat* Fm is a glaciogenic unit within the Katanga Supergroup of the Pan-African Lufilian orogen in Central Africa. The succession begins with transgressive Roan Gp resting unconformably upon pre-Katangan basement in the first intracratonic rift related to the extension of the Rodinia Supercontinent. Renewed rifting and rift propagation northwards resulted in marine Nguba Gp deposition. Both units contain extension-related igneous rocks. Orogenic closure is marked by two major contractional events, northward propagation of Katangan nappes and formation of two foreland basins filled with sediments of the Kundelungu and Fungurume Gps deformed in the external fold-thrust region, beyond which the continental molasse of the Plateau Gp extends to the N. Two glaciogenic units are recognized within the Katangan. An older *Grand Conglomerat* within the Nguba Gp correlated with the global Sturtian glaciation (<765 and >735 Ma in age) and a younger *Petit Conglomerat*, at the base of the Kundelungu Gp., correlated with the global Marinoan/Varangian glaciation (ca. 620–600 Ma). The thickness of the glaciogenic strata reaches 950 m. Each of these glaciogenic units is succeeded by cap carbonates.

The sedimentary environments of the *Grand Conglomerat* vary from marine to continental, and the facies associations are partly controlled by tectonics and rift asymmetry. Adjacent to the strongly uplifted southern margin of the rift, a proglacial fan delta facies dominated by gravelly debris flows grade distally to glacial melt-out (dropstones deposited simultaneously with muddy-silty suspension), debris flows, turbidites and deposits of traction currents. By contrast, continental glaciofluvial sediments at the N rift margin pass basinward to a graded shelf association of massive marine tillites interbedded with pebbly arkoses.

The correlatable regional unconformities at the base of the glaciomarine strata at both N and S margins of the basin reflect eustatic sea-level changes, whereas relative block movements in the evolving rift controlled local unconformities. The most prominent is a syn-*Grand Conglomerat* horst of the pre-Katangan basement rocks below an unconformity at the base of a condensed glacial laminite (only 0.5 m thick). These stratigraphic relations date the Kafue Anticline, a prominent basement high around which the Copperbelt of Zambia is located, as a feature that originated after deposition of the Roan Gp and shortly before the *Grand Conglomerat* glaciation.

The palaeomagnetic results (Wingate *et al.*, 2004 and Collins and Pisarevsky, 2005), which indicate that the NW Zambia/S Congo region was located at the Equator between about 800 and 750Ma, are consistent with the ‘Snowball Earth’ hypothesis. However, the interlayering of glacial and non-glacial sediments is similar to Phanerozoic glaciogenic sequences and the presence of continental glacial sediments and floating glacier-derived fall-out facies in the *Grand Conglomerat* would militate against the ‘extreme frigidity’ of a ‘Snowball Earth’ (Fairchild and Kennedy, 2007). Thus, the following features indicate that the Grand Conglomerat sediments were deposited during a complex multistage event (with glacial and inter-glacial stages): syn-glacial, fan delta successions; gravity flow deposits and deglaciationrelated fall-out facies alternating with massive dropstone-devoid mudstones of glacial maxima; deglaciation stages marked by vertical successions of separate marine tillites, in more proximal settings separated by interglacial marine sandstone complexes. These features imply prolonged glaciation with interglacial periods and gradual deglaciation associated with redeposition of interglacial and post-glacial debris accumulated in the source areas, into the adjacent marine depository. The observed sedimentary facies indicate a lack of permanent sea ice cover at certain periods during deposition of the *Grand Conglomerat* sediments and suggest that this glaciation did not undergo rapid change to a greenhouse environment, contrary to the requirements of the Snowball Earth model.