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Syn-rift, syn-glacial and syn-orogenic sedimentary mélanges as indicators of tectonic and palaeoclimatic evolution of the Lufilian Belt, Neoproterozoic-Lower Palaeozoic of Central Africa

Marek Wendorff

Faculty of Geology, Geophysics and Environmental Protection, AGH University of Science and Technology, Kraków, Poland (wendorff.marek@gmail.com)

The Lufilian belt is an important segment of the Neoproterozoic-Lower Palaeozoic orogenic network within southern and central Africa. It deforms a sedimentary suite of the Katanga Supergroup (880-500 Ma). Mélange occurrences, traditionally called the Katangan breccias/megabreccias, are a prominent feature of the belt architecture. Some mélange bodies reach thickness of 2000 m and contain huge blocks of Katangan rocks. They were previously considered as tectonic mélanges ("friction breccias") marking regional decollement zones related to thrusting during the Pan-African orogenesis. However, these fragmental rocks were recently shown to be of sedimentary origin. They form two regionally extensive olistostrome bodies and one glaciogenic unit. The main lines of evidence for the olistostrome genesis are following: (1) lack of pervasive shearing that would point to tectonic fragmentation; (2) textures and structures diagnostic for subaqueous sediment gravity flows ranging from debris flows to turbidites; (3) roundness and provenance of clasts, and lateral facies gradients implying erosion, abrasion and unroofing of the Katangan source rocks elevated in the source areas; (4) lower boundaries of fragmental bodies are not tectonic but stratigraphic; (5) injections of unconsolidated conglomeratic matrix filling open joints in allochthonous blocks embedded in olistostrome lithosomes.

The oldest mélange is a disorganised to locally organised syn rift olistostrome complex with olistoliths reaching 5 metres across. The clasts were derived from the uplifted rift margin and redeposition resulted from mass-wasting (rockfalls producing sedimentary breccias), sliding of solitary blocks, and pebbly to cobbly debris flows.

The succeeding glaciogenic mélange complex originated during the Grand Conglomerat glaciation (correlative to the Sturtian glacial). It consists of disorganised clast-in-matrix facies that resulted from glacial erosion of the uplifted rift margin and redeposition of the glaciogenic detritus into the proximal part of a deep marine basin by debris flows. This proximal chaotic complex passes laterally into an organised suite of distal muddy megaturbidites and small-scale sandy turbidites containing melt-out dropstones.

Synorogenic olistostromes composed of nappe-derived megablocks up to several kilometres in size embedded in debris-flow conglomerates are the youngest mélange units. These components, derived from the Katangan nappes thrust northwards, were deposited in the foreland basin of the Lufilian Belt.

Sedimentary genesis of the Katangan mélanges revealed two previously unrecognised sedimentary basins of regional extent, broadened our insights into the glaciogenic deposition in the southern part of the region and enabled stratigraphic revisions of the Katanga Supergroup to reflect the main stages in the tectonic evolution of the belt. The Roan Group records rifting and marine transgression at <=880 Ma. Subsequent uplift (>=765 Ma) affected southern part of the Roan basin, terminated the deposition of the Roan Group and led to opening of the Nguba rift that expanded towards the north. Olistostromes defining the base of the Nguba Group prograded beyond the northern margin of the Roan rift and were deposited nonconformably upon pre-Katangan basement in the northern part of the Nguba rift. During the Sturtian (Grand Conglomerat) glaciation, the depository was an asymmetrical rift with strongly uplifted southern shoulder at the foot of which clast-in –matrix sediments were deposited by voluminous debris flows.

The first orogenesis occurred in the south and resulted in deposition of the Kundelungu Group. During the second orogenesis (<575 Ma), north-advancing nappes with Katangan strata formed elevated sources that shed coarse detritus into the foreland basin ahead to form the Fungurume Group, which evolves from a deep-marine olistostrome grading upwards to fan deltas and red-bed stream deposits to shallow marine siliciclastic-carbonate strata.