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The relevance of the sedimentary history of the *Grand Conglomerat* Formation (Central Africa) to the interpretation of the climate during a major Cryogenian glacial event

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ABSTRACT

The Cryogenian *Grand Conglomerat* Formation (<765 and >735 Ma in age and with considerable thickness variations up to a maximum thickness of about 950 m) is an association of interbedded glaciogenic, clastic, periglacial and non-glacial deposits topped by the Kakontwe Limestone cap carbonate. These units occur within the Nguba Group of the Katanga Supergroup, which was deposited in a rift basin and subsequently deformed as part of the Pan African Lufilian orogenic belt that separates the Congo and Kalahari cratons. Both, correlation of regional unconformities and facies distribution suggest that the *Grand Conglomerat* sediments were deposited (during and after eruption of flood basalts) in an asymmetrical rift, with a strongly uplifted southern shoulder, and a graded shelf defining the northern margin. Glaciomarine sedimentary rocks along the southern margin of the Katangan rift are preserved within fan delta conglomerates supplied from an elevated rift shoulder. By contrast, the northern margin of the rift was the site of continental glaciation with cross-bedded, glaciofluvial and marginal marine sandstones and conglomerates, associated with massive tills (glaciogenic diamictites) that pass laterally towards the south into glaciomarine mixtite interlayered with wedges of dolomitic sandstone. The Kakontwe Limestone cap carbonate is present only in the distal parts of the basin. Its absence in proximal regions is considered to reflect very high rates of sedimentation of fine-grained, glaciogenic debris derived from deglaciated source areas. Palaeomagnetic data indicates that the *Grand Conglomerat* glaciogenic sediments were deposited close to the Equator during the Cryogenian. This low latitude setting coupled with the absence of a topographical trigger would suggest that glaciation was related to global atmospheric cooling. However, the presence of water-borne, glaciogenic, on-shore sediments and offshore sediments derived from floating glaciers suggests that the ocean during this part of the Cryogenian was not completely frozen. Associations of glaciogenic facies with non-glaciogenic sedimentary rocks imply glaciation with interglacial periods and gradual deglaciation, instead of severe conditions of permanent sea ice cover and rapid change to the greenhouse environment.

1. Introduction

Major glacial events define the Cryogenian Period (ca. 850–630 Ma) of the Neoproterozoic Era. The global distribution and apparent synchronicity of preserved Cryogenian glacial sequences has been the basis of the Snowball Earth hypothesis (Kirschvink, 1992). As a test of the hypothesis it is necessary to understand the relative importance of local (topographical, geographical and geological) controls relative to global atmospheric controls on different parts of correlated Cryogenian glacial events. The present paper describes the *Grand Conglomerat* (of the Katanga Supergroup), which is the oldest Cryogenian glacial unit of central Africa and which has been linked to the global Sturtian glacial event (Wendorff et al., 2000; Frimmel et al., 2002; Key et al., 2002; Master et al., 2002; Bodiselitsch et al., 2005).

The Neoproterozoic–Lower Palaeozoic Katanga Supergroup is exposed in the Lufilian belt (central African part of the continental system of Pan African orogenic belts also known as the Lufulian Arc; inset map of Fig. 1), and also forms a less deformed plateau molasse/foreland sequence over the Congo Craton (Fig. 1). Katangan sediments were initially deposited in intracratonic rifts related to early Neoproterozoic extension of the ca. 1000 Ma Rodinia Supercontinent. Initial rifting commenced at about 880 Ma based on an age of 879 ± 19 Ma for the Kafue rhyolites found in the lowest rift sedimentary sequences (Wardlaw quoted in Hanson et al., 1994)

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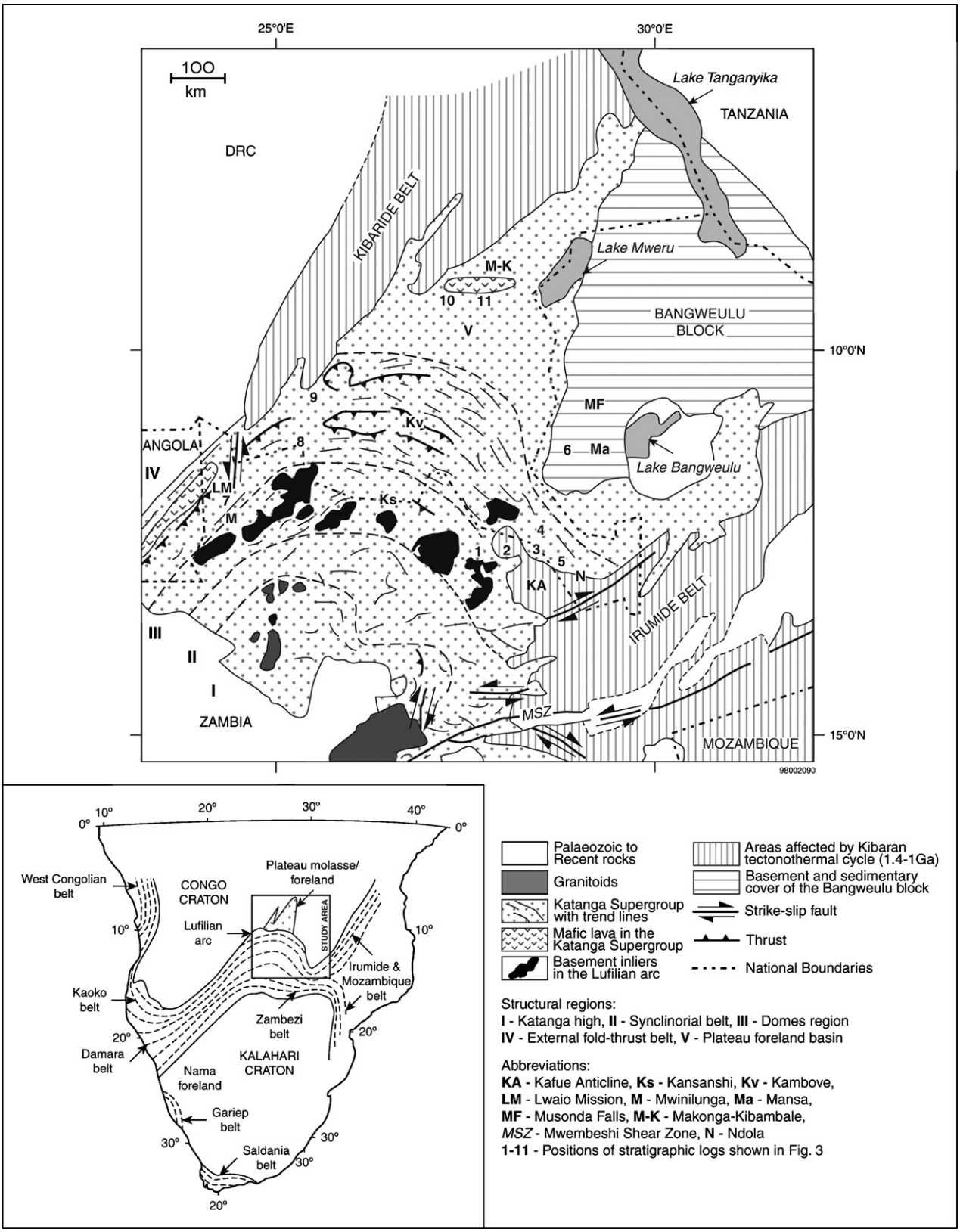

Fig. 1. Regional geology of the Lufilian belt (modified from Porada and Berhorst, 2000; and from Wendorff, 2003). Localities discussed in the text: L—Lwaio Mission, M-Mwinilunga, Ks—Kansanshi, MF—Musonda Falls, Ma—Mansa M-K—Makonga-Kibambale. 1–10: positions of stratigraphic logs shown in Fig. 3. Box outlines the area shown in Fig. 2 and inset shows the position of the Lufilian arc in the Pan-African orogenic belts system in central and southern Africa.