

Fluvial to lacustrine facies characterisation using wireline logs.

The Tertiary Melut Basin, Sudan.

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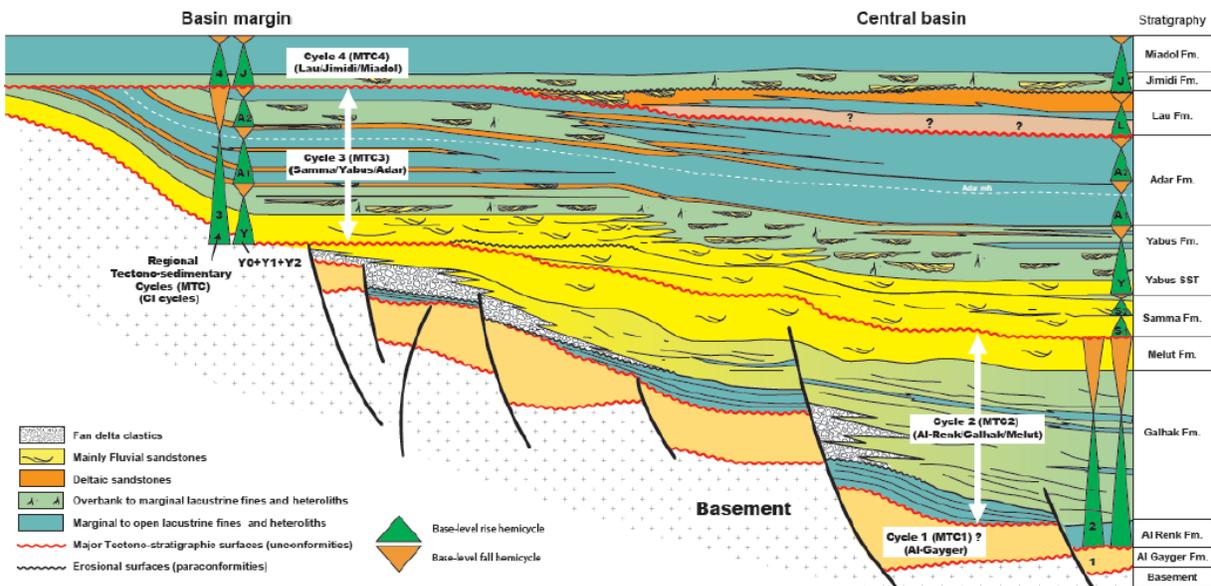
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The Melut Basin is a Cretaceous to Tertiary rift basin and forms the southern part of the extensive White Nile Rift System, which is itself part of the extensive Central African Rift System. The sedimentary infill of the basin is dominated by fluvial and lacustrine sandstones, mudstones and local tuffs of Upper Cretaceous to Quaternary age. Distribution of facies is likely to have been controlled by pulses of fault-controlled subsidence followed by more prolonged episodes of thermal subsidence.

A sedimentologic and stratigraphic scheme was extended throughout the Melut basin using 200 available wells and 3D/2D seismic tie, therefore providing a robust sequence stratigraphic frame constrained by sound biostratigraphy.



observed stratigraphic relationships, main tectono-sedimentary cycles are emphasized as well as main depositional styles (sedimentary environments)

Melut basin stratigraphic scheme

Four major facies associations define the major depositional environments throughout the Basin:

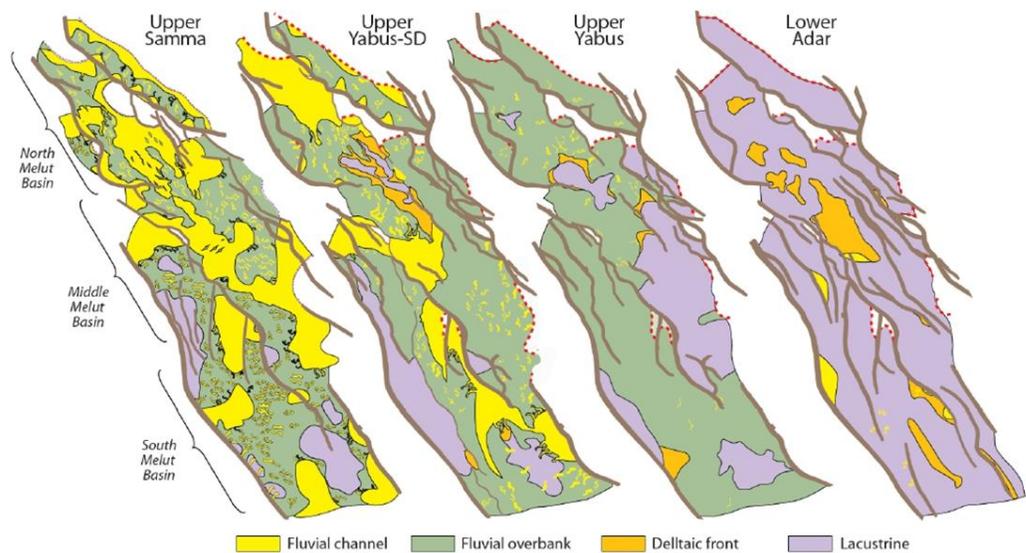
- 1) Fluvial channels, present either as multi-storey and single-storey channels. The stacked amalgamated channels are more characteristic of the Samma and Yabus Sandstone intervals. They are typical of high-energy fluvial systems such as braided rivers. The single-storey channels are more typical of the upper part of the Yabus Sandstone, the Yabus and the lower Adar Formation, and they correspond to lower energy fluvial systems such as meandering channels.
- 2) Overbank deposits, consisting mainly of fine deposits (siltstones, claystones and heteroliths). Subaerial floodplains; Ephemeral lakes with palustrine conditions; Crevasse splay

complexes with their corresponding heterolithics. 3) Delta and shoreface deposits, mostly sandy in nature and strongly associated with lacustrine facies. 4) Open lake, with prodelta to offshore lacustrine claystones.

The major depositional environments show alluvial fans to fan deltas coexisting with braid-plain at the foothill of escarped blocks and a large drainage system (with both axial and lateral contribution), that feeds a restricted and shallow lacustrine system. This conceptual scheme represents the dominant environments throughout the infilling of the Melut Basin during Samma up to Jimidi times, with periods of more active tectonics and significant base level rises (Adar for example). The first order fining-upward succession of the Samma/Yabus/Adar interval is clearly emphasized. It is associated to a long-term base-level rise, leading to retrogradational trend, where depositional environments gradually pass upwards from amalgamated fluvial channels to less amalgamated to finally marginal lacustrine and associated deltaic heteroliths eventually leading to fully lacustrine in the Adar Formation. The basin infilling is complex due to distinctive sediment entry points along the basin (e.g. axial drainage system versus lateral supply from rift flanks) and the areas of confluences.

A link is established (from core description) between the logs and the major distinctive depositional environments representing accurately the main sedimentary facies recognizable on wireline-logs response allowing the correlation of all available wells. In order to characterize, at the basin scale, individual stratigraphic sequence, an automated definition of main lithologies (along wells) using computation methods based on neutron-density and computed VSH_ND logs is performed on the 200 wells coupled to the RESFLAG. Therefore, four lithologies are defined: F1: Sandstones with porosity <15%, F2: Sandstones with porosity >15%, F3: Siltstones, F4: Shales. In each well, each sequence composed of association of Facies 1; F2; F3 and F4 represents a specific lithologies association. The final step consists in statistical analyses (Vertical Proportion Curve) of these lithologies associations (per well) composing a sequence across the basin (all wells). VPC diagram are organized such as all wells are sorted by claystones content. This allows appreciating the spatial variation of lithologies associations (throughout the basin) for one sequence.

This new methodology demonstrates specific VPC responses per sedimentary environment providing a useful tool (especially in basin with limited direct sedimentary evidence) in order to recognize specific sedimentary environment (in continental fluvio-lacustrine system) and sandstones connectivity.



Paleoenvironment evolution from Samma to Adar times over the Melut basin