Sedimentary Characteristics and Forward Stratigraphic Modeling of Traction Flow Driven Fan Delta in Steep Slope Zone

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Abstract

The steep slope zone of the rift basin usually accompanies with an alluvial fan formed by gravity flow, which enters into the lacustrine water and then forms a near-shore subsurface fan. However, a fan-delta system formed by the traction flow lies on the large bounding faults in the south of Albert rift in Uganda. This paper illustrated the characteristics of this special deposition system by an integrated qualitative and quantitative methods, moreover sedimentary forward modeling provided a circumstantial genesis mechanism and evolution process for the fan-delta. Comprehensive analysis of core description, logging curve, heavy mineral content, particle size analysis and other data are used for sedimentary facies analysis, then depositional parameters including accommodation space, source supply and sediment transportation are quantitatively determined. The astronomical time framework of the basin was established by the Milankovitch cycle method. The 4D forward stratigraphic modeling was used to analyze the genetic mechanism of the traction flow driven deposition and reveal the evolution pattern of the sedimentary process over geological time. The core is characteristic of medium-fine grained sandstone and abundant cross beddings with rare gravels, which indicates a sort of lower-energy and longer-distance transportation mechanism compared to gravity driven flow. The amount of the algae distribution showed that the paleo-water depth was shallow when the sediments deposited. The trend of heavy mineral and formation thickness indicated that the sediment source located on the east side of the boundary fault in the southeastern part of the basin. An astronomical framework was established and it

showed that the fan delta began to form at 12.74 Ma and stop at 11.93 Ma. The basin began to accept sediments at about 14.5-15 Ma. At this time, the rift was in the early stage of formation, and the fault throw of the eastern bounding fault is far less than present. During the process of basin uplift, the boundary faults were continuously eroded. The seasonal water flow continuously flushed the fault bedrock to form a series of eroded deep trenches, which further reduced the distance between the source zones and the sedimentary zones. Thus creates the basic conditions for a traction flow. The response patterns of sedimentary features to various sedimentary control factors are analyzed through forward stratigraphic modeling based on the diffusion equation, and the sedimentary evolution model of the tractive fan delta in steep slope zone with geological time is established. This paper proposes a special fan delta system driven by the traction flow, which located at the steep slope of the bounding fault. The quantitative forward stratigraphic modeling helped us to get more insight into the deposition mechanism and reconstruct the sedimentary evolution process of this complex system.