THE OKAVANGO DELTA—SEMIARID ALLUVIAL-FAN SEDIMENTATION RELATED TO INCIPIENT RIFTING

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Abstract: The Okavango "Delta" is a large (25,000 km^2), low-gradient (1:3400) alluvial fan which has developed in a depression between two basement arch–horst systems which mark the tips of incipient rifts. Base flow in the Okavango River sustains about 4000 km^2 of permanent wetland in the Delta, while the seasonal flood can expand the area of inundation to more than 12,000 km^2. The climate over the Delta is semiarid, and only 2% of combined inflow plus rainfall (ca. 15 km^3/yr) leaves as surface flow, the remainder being lost to the atmosphere by evapotranspiration. Sedimentologically, the system is virtually closed, and about 600,000 tonne of sediment is deposited annually in the Delta, resulting in a very low average sedimentation rate. Two distinct types of sedimentation occur on the fan: clastic on the upper fan and chemical on the lower fan. In both, biotas play a key role. Although the region is tectonically active, there is little active faulting within the Delta itself, and apart form the rising arches associated with the propagating rifts, the major tectonic process in the Delta appears to be crustal sagging, induced by sediment accumulation. This has caused localized depression of the southeastern arch and associated faulting. Seismicity is localized to the area of the fan, and is also attributed to gravitational loading. Continued propagation of the rift is likely to result in diversion of the Okavango River into the Zambezi River.

INTRODUCTION

Depositional conditions in rifts vary widely, depending particularly on the stage of rifting and local climate. Many examples of rift sedimentation have been documented, particularly along the East African Rift (e.g., Frostick et al., 1986). The majority of studies have been carried out in well defined rift systems, while few have examined sedimentation associated with the very early stages of continental rifting. The southern tip of the southwestward propagating East African Rift affords an opportunity to examine this early stage of sedimentation. Here, the courses of the Kwando and Okavango Rivers have been disrupted by incipient rifting, creating local depositional basins, in which the Linyanti and Okavango wetlands have developed (Fig. 1).

The Okavango "Delta" wetland is a large (25,000 km^2), low-gradient (1:3400) alluvial fan occupying a local depocenter within the larger, intracontinental Kalahari Basin. The Delta is situated in a semiarid environment, but base flow in the Okavango River at the head of the fan is sufficient to sustain about 4000 km^2 of permanent swamp. This is flanked by seasonal swamp, which may attain up to 12,000 km^2 in area. The system is essentially closed, inasmuch as virtually no sediment leaves, and 98% of the inflow is lost to the atmosphere by evapotranspiration. Moreover, anthropogenic impact on the Delta is minimal, and both the catchment and the Delta remain undeveloped. Little is known of the subsurface stratigraphy, but depositional processes presently active on the fan have been studied in considerable detail. Structural and seismic studies have provided insight into the local tectonic setting of the Delta.

The Okavango Delta therefore provides an opportunity to examine fluvial style and sedimentary processes in the very early phases of rifting, albeit under relatively unusual conditions. Moreover, the Okavango Delta provides insight into fluvial behavior in bedload-dominated systems under quasi-steady flow conditions as well as sedimentary processes under conditions of extreme evapotranspirational loss. In addition, it provides excellent examples of the myriad roles played by biotas as they bear on geomorphic and sedimentologic processes. This paper emphasizes geomorphologic aspects of the Delta, because of the lack of subsurface information.

REGIONAL SETTING OF THE OKAVANGO DELTA

The Kalahari Basin

The Delta is situated within, and is an integral component of, the intracontinental Kalahari Basin, and it is necessary to examine the regional settings and interrelationships of both in order to differentiate between intracontinental and rift-related sedimentation.

The gross geomorphology of southern and eastern Africa is dominated by the African Superswell (Nyblade and Robinson, 1994), a region of relatively elevated terrain which manifests itself both on continental Africa and on the ocean floor to the south-

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