The Neogene Succession of the Albertine Graben, Uganda: Recent Efforts to Set up a Coherent Stratigraphic Scheme*

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Abstract

The Albertine Graben forms the northernmost part of the western arm of the Great East African Rift System (EARS). It stretches over a total distance of over 500 km from Rwanda in the South to Sudan in the North along Uganda's western boundary with the Democratic Republic of Congo. It has been known for many years for its oil seeps along the margins, with no major oil discovery until recently after massive discoveries in Uganda, demonstrating its hydrocarbon potential. The lithostratigraphic schemes that have been existent in this petroliferious Neogene succession have been inconsistent, each depending on its author and for a limited part of the Graben. They are based almost solely on surface exposures using mammalian and molluscan evolutionary trends. Sediment thickness of up to 6 km have been suggested but hydrocarbon discoveries that have been made so far are in perched terraces on the graben's margins hence, additional discoveries can be expected in the deeper and more central parts of the Graben once exploration progresses to this parts.

In order to facilitate more targeted exploration and to enable a reliable total resource assessment for the entire Graben, a coherent regional stratigraphical framework must be established. Recent work, involving re-examination of all relevant data has however led to significant new insights into the development of this Neogene petroleum province. The interplay of lacustrine and alluvial environments, with varying degrees of subsidence, tectonism and resultant variations in lake levels, have all affected axial and marginal clastic input to the basin. These in turn have led to the development of a complex stratigraphical scenario: although

correlation between surface and subsurface intervals is not always immediately evident, our work displays the importance of integrating information from both realms including a systematic sampling and resampling of surface tuffs together with bottom hole and shallow core palynostratigraphic studies among other methods as the tools to resolve problems of intrabasinal correlation.

Introduction

The Albertine Graben forms the northernmost part of the western arm of the East African Rift System (EARS), stretching more than 500 km from Rwanda in the south to Sudan in the north along Uganda's western boundary with the Democratic Republic of Congo. This Cenozoic rift basin developed over the Precambrian orogenic belts of the African craton (Figure 1). The graben trends in a NE-SW direction through most of its length and is subdivided into several sub-basins. These are contained within three - southern, central and northern - structural domains (Figure 2). These major domains are separated by transfer zones marking shifts in marginal fault activity.

The graben's marginal oil seeps have been known and remarked upon for many years but no major oil discoveries were made until recently. The hydrocarbon potential of this Neogene petroleum province has now been clearly demonstrated by the many petroleum discoveries that have been made in Uganda, with over 2 billion barrels of oil in place discovered so far. Modern lithostratigraphical schemes for surface exposures in some parts of the graben were informally established between 1985 and 1992, when exposures were correlated using established mammalian and molluscan evolutionary trends and tephrostratigraphical correlations of isolated tuffs to well-dated volcanic sequences in Kenya and Ethiopia (Pickford et al 1993). These and other studies suggested continuous deposition of up to 6 km of sediment from the middle Miocene to Recent. Hydrocarbon discoveries that have been made so far are in perched terraces on the rift's eastern margins, but with no exploration in the deeper and more central parts of the graben. Additional discoveries can be expected in coming years from the latter areas.

Ongoing Work to Set Up a Coherent Stratigraphic Scheme

In order to facilitate more targeted exploration and to enable a reliable total resource assessment for the entire basin, a coherent regional stratigraphical framework must be established. The primary objective of current efforts therefore is to resolve problems of intrabasinal correlation, with the primary aim of producing a well-constrained lithostratigraphical framework which integrates surface and subsurface information from this new and significant petroleum province. This work therefore involves detailed analyses of seismic, gravimetric and geomagnetic data, integrated with information from wireline logs, sedimentological, biostratigrapical and,

chemostratigraphical studies, together with radiometric data from tuff samples collected from field exposures, and new bottom hole and shallow core palynostratigraphic studies.

Surface exposures in most parts of the graben are characterized by ironstones that mark major breaks, condensation and bypass while the subsurface shows a more complete succession that fits with models for lacustrine rift development. Work so far has established surface to subsurface correlations in some parts of the graben. Formal lithostratigraphic schemes are also proposed for some basins. (Figure 3 and Figure 4) This approach will facilitate better understanding of the significant events in the evolution of the entire graben.

This (work) in turn has led to significant new insights into the development of this Neogene petroleum province. It is clear that the graben is characterized by interplay of lacustrine and alluvial environments, with varying degrees of subsidence and tectonism. The resultant variations in lake levels have affected axial and marginal clastic input to the basin. These in turn have led to the development of a complex stratigraphical scenario.

Reference

Pickford, M., 1992, Evidence for an arid climate in western Uganda during the middle Miocene: Compt Rend, Serv 2, v. 315/11, p. 1419-1424.

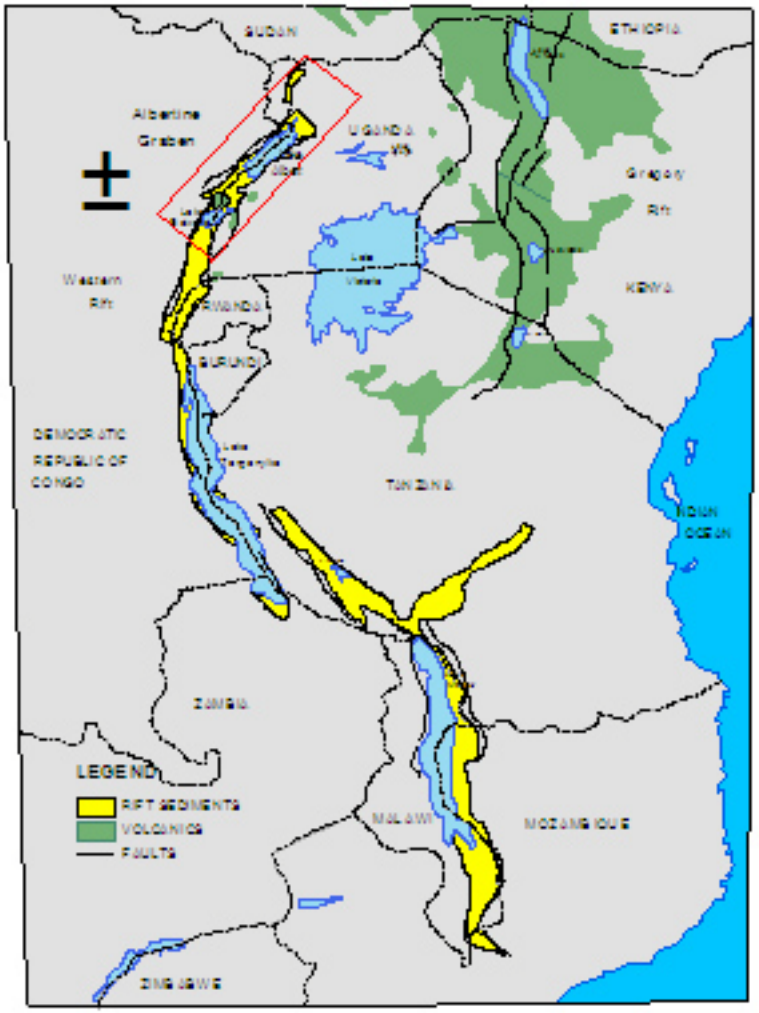

Figure 1. Location of the Albertine Graben.

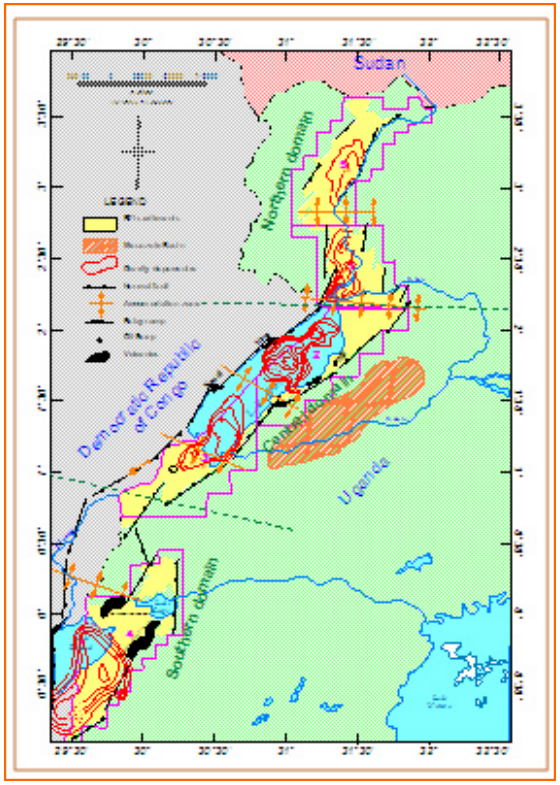

Figure 2. Structural setting of the Albertine Graben.

PROPOSED STRATIGRAPHIC SECTION

Age	Formation	Thickness (m)	Strati-column	Major depositional environments
Pleistocene	Nyabusosi	650		Fluctuating coastal to shallow lacustrine
Late Pliocene	Nyakabingo	210		Repeated prodeltaic to delta front progradations
Late Miocene-mid Pliocene	Nyaburogo	440		Delta plain to delta front with switch from humid to semi-arid conditions uppermost
Late Miocene	Oluka	390		Lacustrine passing up into delta plain with minor fluvial intercalations
Late Miocene	Kakara	540		Lacustrine to delta front to humid delta plain
Mid/Late Miocene	Kasande	115		Lacustrine to humid coastal mud flat
Middle Miocene	Kisegi	>310		Stacked/amalgamated fluvial sandstones in semi-arid conditions

Figure 3. Proposed lithostratigraphic scheme for the Semliki Basin.

Age	Formation	Member	Thickness (m)	Strati-column	Major depositional facies
Plio-Pleistocene	Kaiso Village		~330		Shallow lacustrine
Mid-Late Pliocene	Warwire	Upper Warwire	280		Near shore lacustrine Delta plain
		Middle Warwire	70		Fluvial
		Lower Warwire	120		Progradation Delta Front parasequences with an overall lacustrine regression
Late Lower-Middle Pliocene	Nkondo	Upper Nkondo	15		Deep lacustrine
		Lower Nkondo	353		Near shore lacustrine Fluvial channels

Figure 4. Proposed lithostratigraphic scheme for the Kaiso-Tonya Terrace.