The East African Rift Valley

11 Jan 2017

By Bill Fitches

INTRODUCTION

Bill Fitches is a professional geologist who has both academic and industrial experience. He taught at Aberystwyth University until 1998, then worked for Robertson Research working on basins in Libya, Algeria and West Africa, before becoming an independent consultant to the oil industry. He has conducted studies in many areas of the world and has an intimate knowledge of the East African Rift Valley. He was a lucid and entertaining speaker, overcoming the handicap of the unavailability of the Cube audio system.

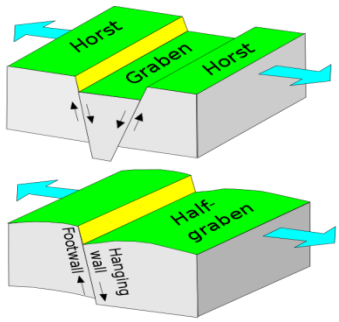
Bill in Kenya with The Oily Boys - oil industry representatives

The East African Rift Valley (EARV) is part of the larger East African Rift System (EARS) and is a place where tectonic forces create new plates by splitting the Earth's surface, resulting in rifts that widen over time. The complete Rift System extends over thousands of kilometres. To the South of this system the EAR divides into 2 main rifts, the Lake Albert (or Albertine) Rift to the West and the Kenya (or Gregory) Rift to the East; the Lake Albert Rift contains the East African Great Lakes.

The Eastern branch is characterised by greater volcanic activity, while the Western Branch comprises deeper basins containing large lakes and lots of sediment.

STRUCTURE

There are two main ways that rifts can form, either by extension of the crust by plate tectonics or the result of deep down processes in the hot ductile crust which cause thinning but does not break the crust, and the mantle rises. The East African Rift is relatively young and the initial process started in the Neogene era (c24m). The Rift formation started about 11m years ago, but didn't really get going until 5.3m. It is thought the split into West and East branches was caused by a small core of old metamorphic rock that was too hard for the rift to go through, so it diverged into the two branches There are several well defined, smaller rift like structures called full-grabens and half- grabens. A full graben is a depressed block bordered by parallel faults; a half-graben is only bounded by a fault along one side. Half-grabens are more common than full grabens.



Diagrammatic graben/half graben

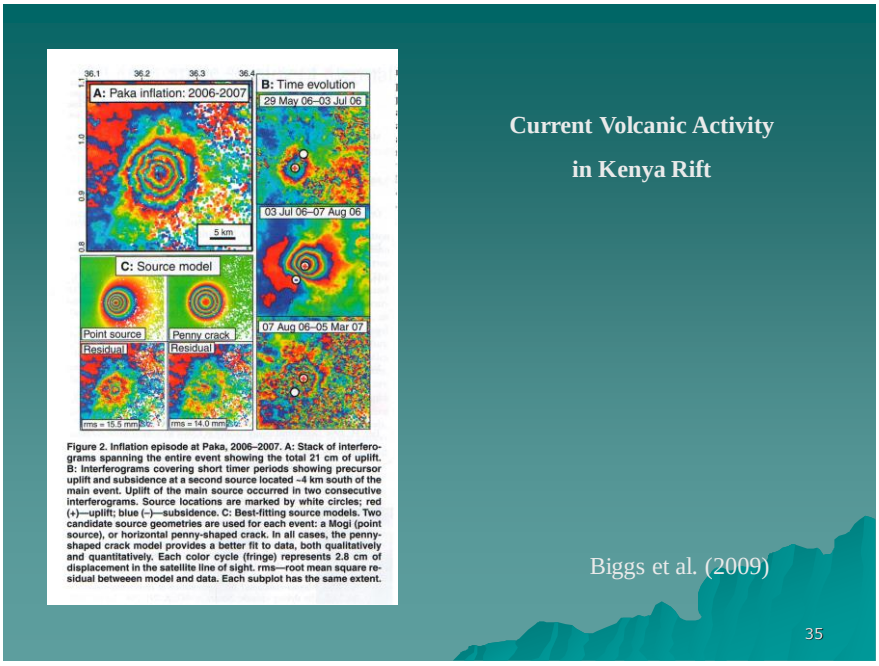
The classic Kenya rift topography is a big drop with asymmetric form; drop can be up 2000 metres. The old volcanic activity produces fertile soil which is used to produce crops for export. Besides the graben/half graben large faults, there are much smaller faults which might only be a few centimetres displacement. Grabens can be filled with sediment with a lake for drainage.

Baringo Half Graben

VOLCANOS

The major remains of volcanic activity are Mount Kilimanjaro (5,895 m) and Mount Kenya (5,199m). Both are the extinct remains of strato volcanos and each comprise 3 peaks.

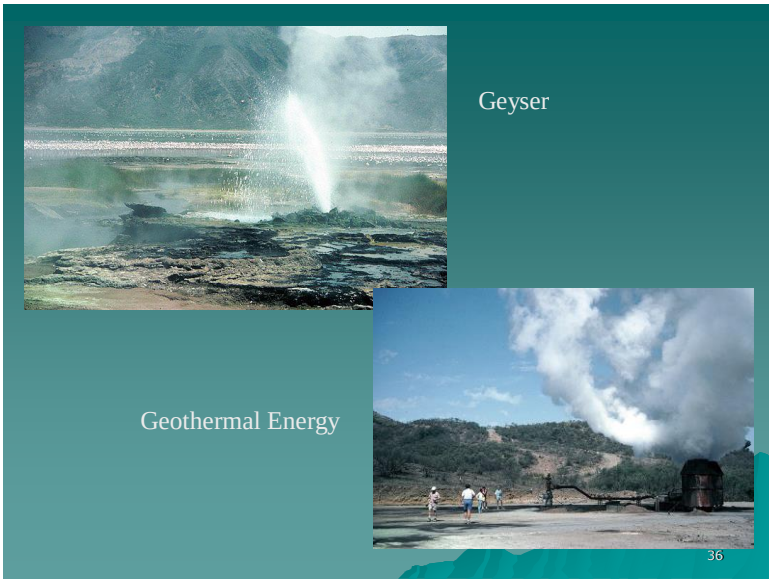
Mount Kenya became in active 3 million years ago and the last eruption from Kilimanjaro was 360,000 years ago. Kilimanjaro has a zonated habitat for vegetation, going from tropical forest, through ferns, cloud forests with fog dependent mosses finally to Erica and heathlands. Mount Kenya is surrounded by forests up through bamboo and finally heathland where trees cannot grow.



There is some current volcanic activity along the main Rift Valley axis and the satellite image above shows how there is uplift due to volcanism. The rings measure

how much uplift there is over time, but this uplift eventually subsides and there is no eruption.

HOT SPRINGS

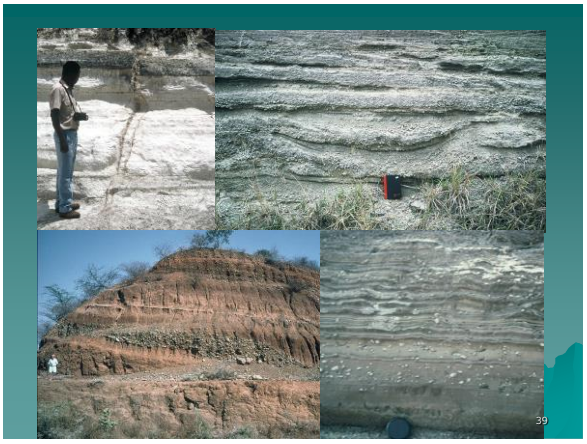


The Kenya Rift valley has reserves of geothermal energy due to the heat processes underground .A BGS study to discover the location of these sources was carried out with the intention of using the heated water to generate electricity. This is would produce environmentally friendly electricity. The main problem is the location of the geothermal sources relative to significant energy users. With Nairobi 100Km from the geothermal sources, the transmission cable losses would be significant and negatively affect the economics of geothermal generation.

Trial Drilling for Geothermal Energy

SEDIMENTATION

When Rift Valley lakes dry out they leave behind sedimentary diatomic deposits, which are the remains of microscopic organisms that us the silicon in water from volcanos; these deposits are collected because they are commercially valuable for use in industrial processes.

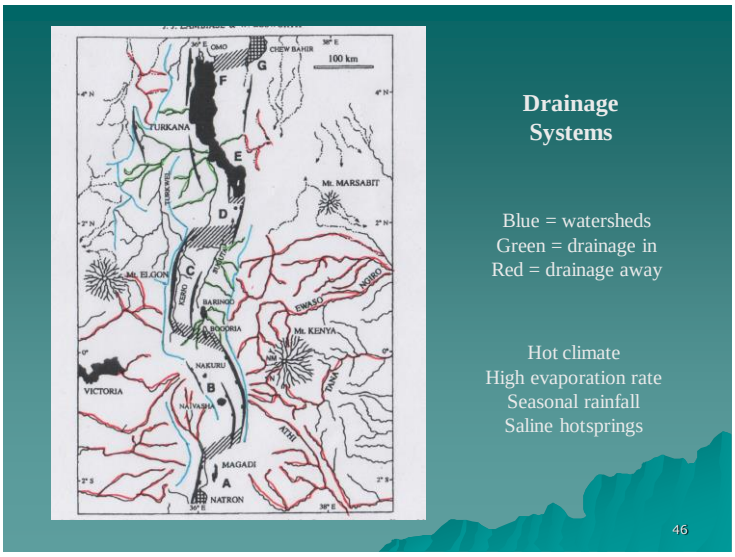


Diatomic Deposits

Sedimentary lakes are also a rich source of fossils and the area is particularly interesting because it contains early hominid fossils. Lake Bogoria is one of these sedimentary lakes and displays a typical half graben formation. It is also a place where flamingos gather.

Lake Bogoria

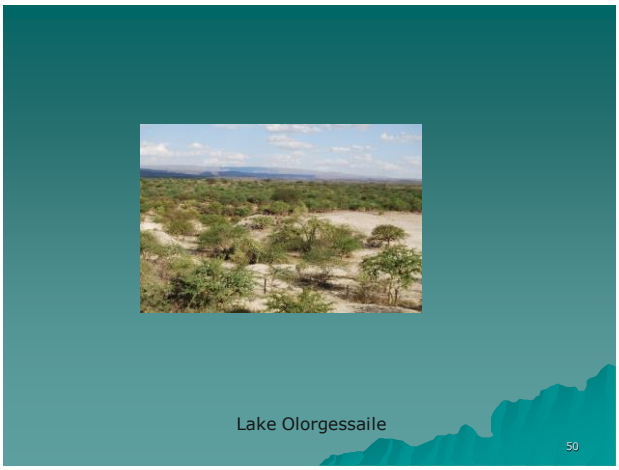
The above view of Lake Bogoria shows a classic Rift Valley half graben .In the distance the steep drop, the lake a result of drainage, the lower tapering and bottom the sedimentation. The green area at the lake edge is algae, which can be a precursor to oil deposits. There is also steam from geyser activity plus small areas white which is tufa.



East African Rift Valley Drainage

The diagram above represents the main drainage systems for the Rift Valley. Most of the drainage is away from the Rift which is set in the crest. The red drainage systems are draining away to the Indian Ocean, the blue to Lake Victoria. The Lakes are saline to hypersaline, so producing a huge amount and variety of vaporites. These vaporites can be commercially valuable and some are being extracted and sent to industrial plants for processing .Transport costs, however, are expensive.

HUMAN EVOLUTION



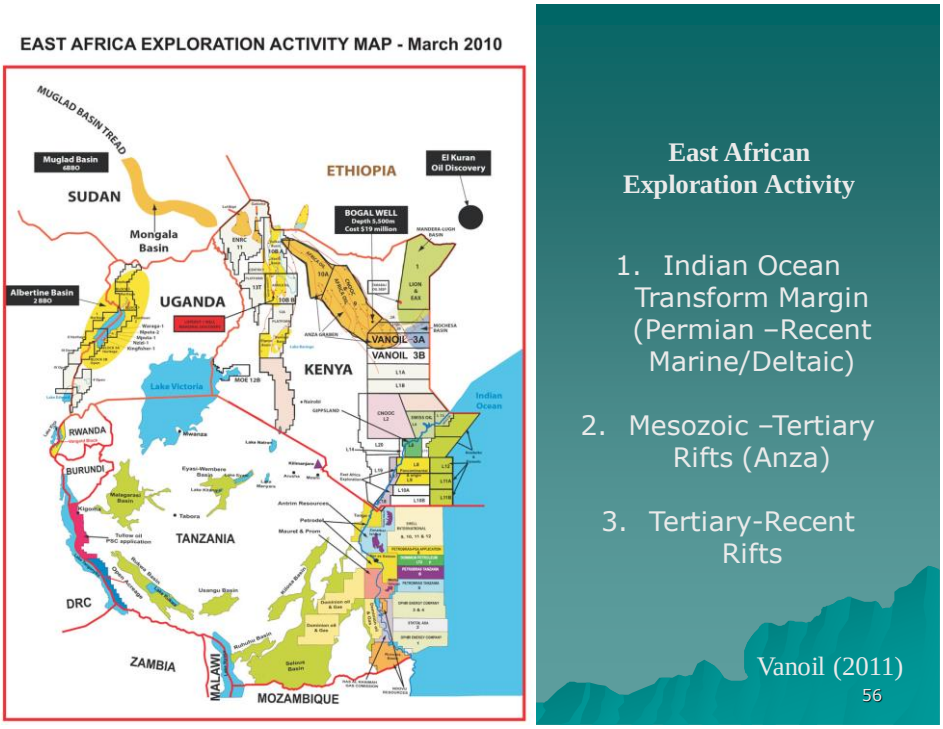
The region is important for understanding the start of human evolution. Lake Olorgessaile, now dried up, is an important anthropological site .It is a source of early (about 750,000 years ago) human implements, such as hand axes. The dried up bed shows diatomic soil.

Deposits of hand tools

The reason for so many implements in one area is could be that layers of sand were washed away leaving the tools in one layer.The implements would not have been hard wearing because they were made from volcanic materials, although there is some obsidian in the area.

Oil exploration in Kenya

A lot of drilling for oil deposits is being done on Kenya and reasonable deposits have been found, but no production has been started. One main problem is the need for the oil to be transported across neighbouring countries, which brings significant political problems into play. This could make exploitation difficult or near impossible.



The map above shows East African exploration activity up to March 2010. Huge deposits of gas have been found in the multiple blocks along the East coastline, but gas is not in demand and would have to be exported with all it's consequent problems.

This was a very good presentation by a very experienced geologist who was able to put across a lot of information in an easy going but professional manner.