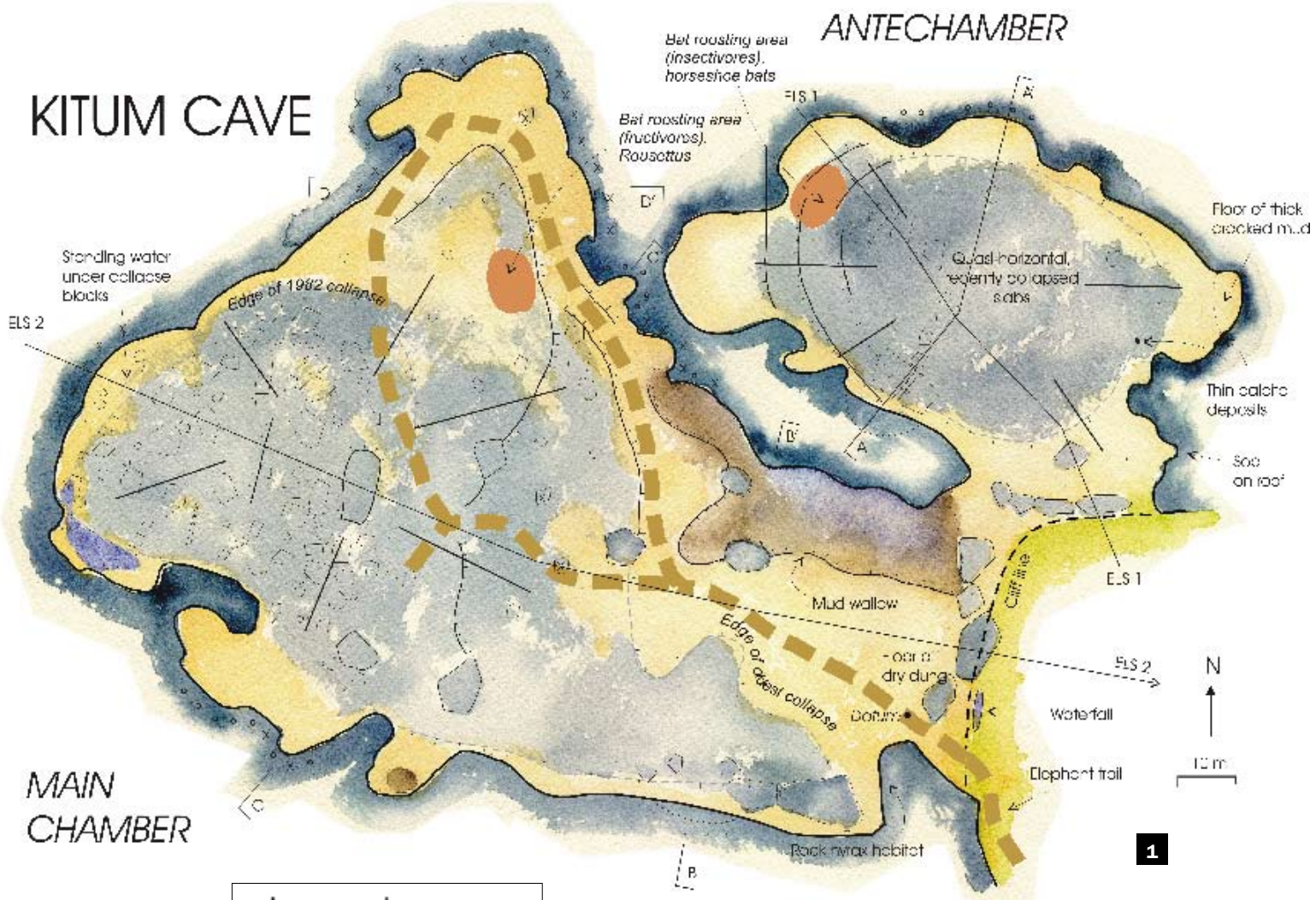
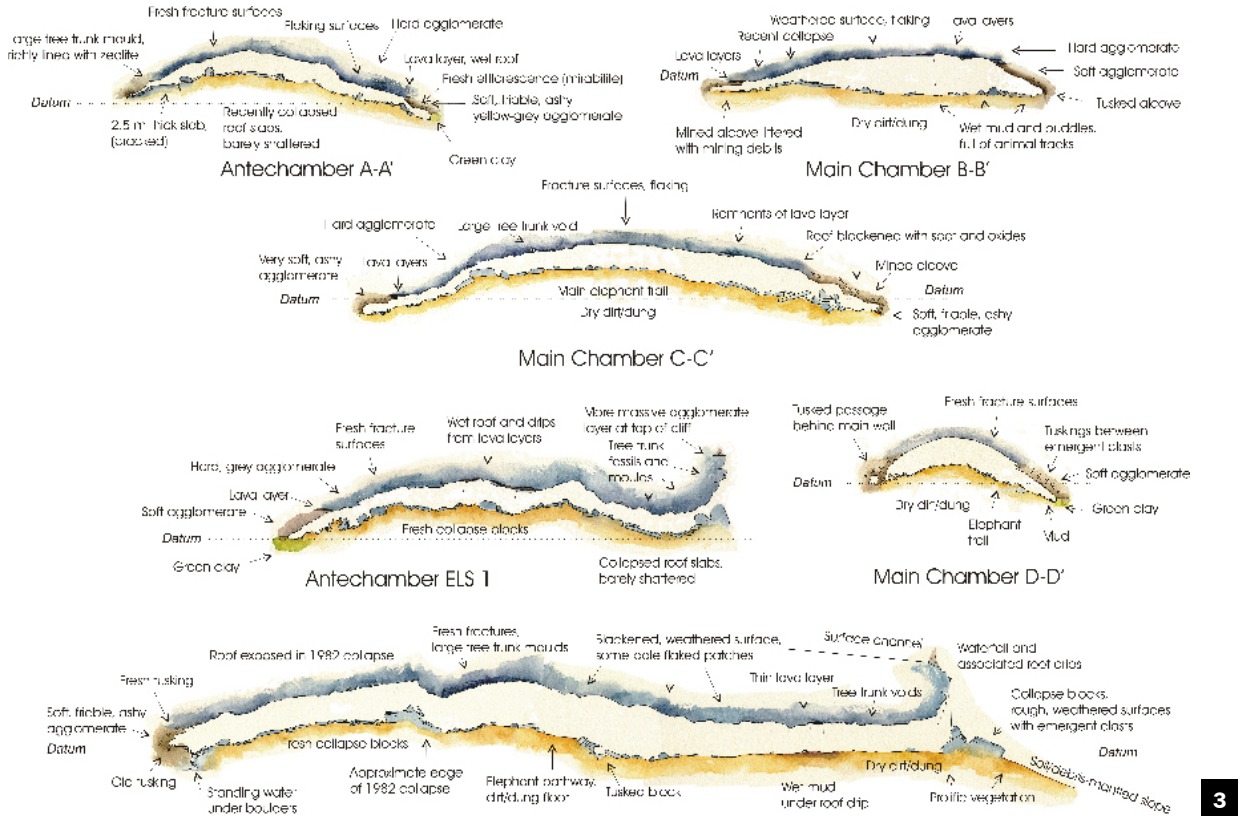


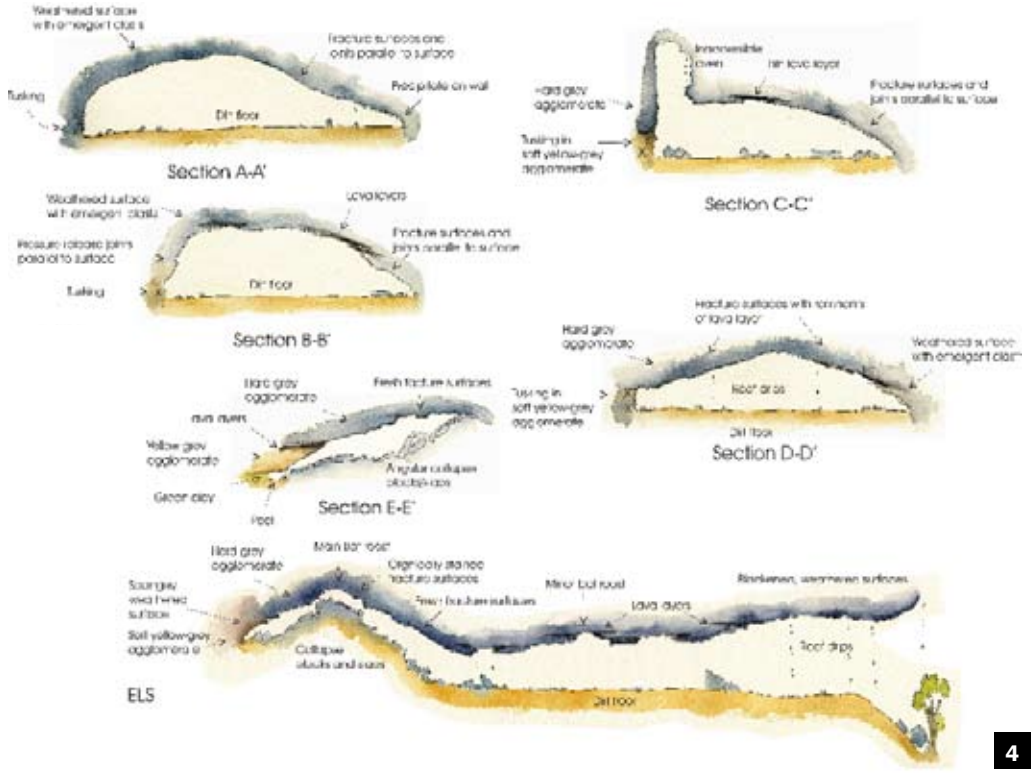
Maps of Kitum Cave (1), Mackingeny Cave (2), sections of Kitum Cave (3), and sections of Mackingeny Cave (4).



3

Mount Elgon's 'elephant caves'

Joyce Lundberg *and* ***Donald McFarlane*** *contemplate and map the extraordinary underground attractions of western Kenya's Mount Elgon National Park.*



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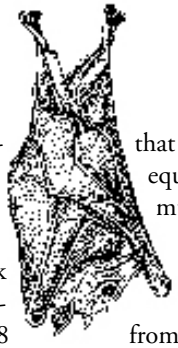
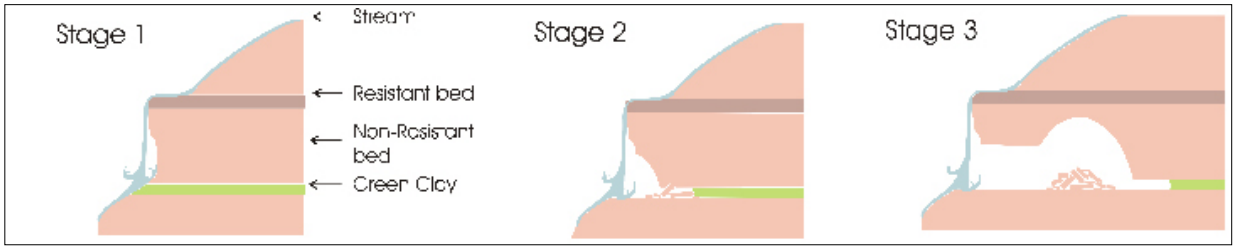


One of Kenya's least visited parks, the Mount Elgon National Park protects a narrow band of forest climbing the eastern flank of East Africa's fifth highest massif, standing 4,321 metres (14,178 feet) above sea level *(see map below)*.

For most visitors, the Park's principal attraction rests in its suite of unique caves, of which the Kitum and the Makingeny Caves are best known. Used by the Elgony people for centuries, the Elgon caves came to wider attention through the writings of Joseph Thomson (*Through Masai Land*, 1885), and are thought to have been the inspiration too for H. Rider Haggard's best-selling novel *King Solomon's Mines*, also first published in 1885.

The caves are often assumed to be lava tubes – pipe-like passages winding through lava flows – because they are in volcanic rock. The rock is not lava, however, but volcanic agglomerate: a mass of small and large blocks of old solid lava ejected from an erupting volcano along with new fine-grained ash that binds it into a solid rock. The eruptions felled large trees, the fossils of which (or sometimes just trunk-shaped holes) are still entombed in the rock.



The three stages of cave formation.

The caves are not tube-shaped either; rather they have a central passage, semi-circular in cross section and opening out into dome-like chambers floored with piles of collapsed rock slabs from the roof.

So, if they are not lava tubes, then how did these caves form?

The caves have long been known to attract elephants and other animals including buffalos, bushbuck, hyenas, leopards, and rock hyraxes. Over many years, Ian Redmond observed the elephant activity within the caves. He and the BBC have fascinating film footage documenting night visits made by animals to Kitum Cave (*Natural World: Elephant Cave*; BBC/Animal World, UK, 2003, directed and produced by Vanessa Doyle/Berlowitz and Justine Evans).

The herbivores (elephants, buffalos, bushbuck) enter the dangerous environments of the dark cave interiors to consume salts that effloresce from the cave walls. The carnivores enter the cave to prey on animals that are far too busy eating the herbivore equivalent of chocolate mousse to take much notice of their potential fate.

The salts are mainly mirabalite, sodium sulphate (commonly called Glauber's salt), which grows out from the walls and can form curved crystals resembling pig's tusks. The crystals are licked off the wall by buffalos or scraped/gouged out by bushbuck and elephants. Buffalos cannot scrape the rock themselves, so they eat mainly the leftover bits dropped by the elephants. The marks left by bushbuck teeth and elephant tusks are clearly identifiable on the cave walls.

These marks should not be confused with the marks left by pick axes wielded by humans who, until the late 1960s, removed sections of the salt-rich rock to feed to their cattle. The effect of all this salt mining (or 'geophagy') by animals and by humans provides a clue as to the true origin of the caves.

Places where elephants have been most active in their subterranean geophagy are marked by substantial (elephant-sized!) undercuts in the sides of the caves from the floor up to tusk reach. This also happens to large blocks of rock that have fallen from the roof – these become modified into mushroom-shaped rocks on stalks which eventually get so thin the blocks fall over.

Elephants are active throughout the caves, even in the darkest inner recesses. Humans have also carved alcoves, but they remained closer to the light, so the alcoves they carved with their pick axes are not found deep inside the caves. People also cut neater roofs and sorted the material more carefully than the elephants; they took the ash rather than the large blocks of lava that would be too hard for the cattle to eat. Human mine sites can be identified from the pick-axe marks, the rounded leftover lava blocks, and the flat ceilings.

Mining of salts by animals certainly provides an obvious means of creating large alcoves in the walls. However, it turns out that the caves are not quite so simple. The streams that flow down the mountain sometimes encounter bands of resistant rock and form waterfalls. Each cave begins as an initial cavity behind such a waterfall,

the resistant band's forming the roof and the cavity's forming in the less resistant rock underneath. The salts crystallize out from the damp, bare rock of the cavity, the elephants arrive, and the cavity is enlarged *(Stage 1 in Diagram)*.

This mechanism alone does not seem to be sufficient to form big caves. The big caves all form along a band of impermeable green clay that traps water above it (called a 'perched' water table), forcing ground water to flow in a narrow zone in the rock above the clay and confining the majority of the evaporation to the rock surface, and thus the efflorescing salts, to the zone above the clay. The ground-water flow, though slow, inexorably saps away the band of clay, causing continual undercutting of the clay band (helped by small animals such as bushbuck). The rock immediately above the green clay then collapses *(Stage 2)*, its pieces' providing rich salty meals for herbivores, but unfortunately occasionally also trapping the eater – there are often bones to be found under rock falls.

The animals can reach up only a few metres. Thus the cave should be wide and low. Since they are high and dome-shaped, it is obvious that the main passages and chambers have been shaped by roof collapse *(Stage 3)*. We might expect the collapsed pieces to remain in a pile in the passage, but here, while the end chambers are full of recently fallen slabs, the passages are clear of rock debris. It appears that, after some time, geophagy has effectively removed the blocks. An added effect of roof collapse is that it allows the animals to climb on top of the blocks to gain access to higher parts of the cave walls, resulting in the creation of new alcoves at higher levels.

We now have several mechanisms for creation of the caves. But this is not the end of the story. More subtle, yet widespread, processes include the chemical effects of the biological activity of the many thousands of bats that inhabit the interior domes – along with the acidic guano that piles up on the floor.

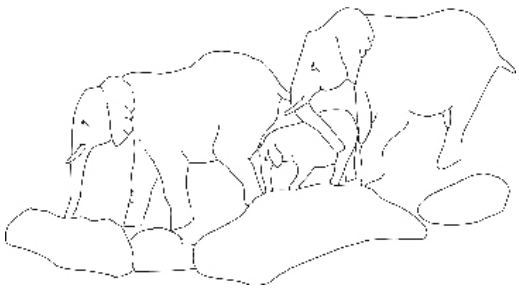
The ecology of the Mount Elgon caves is both diverse and complex. Besides admitting the geophagous mammals and their predators, the caves are roost sites for colonies of tens of thousands of fruit-eating 'Egyptian' flying fox bats (*Rousettus aegyptiacus*) that play a vital role in seed dispersal in the forest. Smaller colonies of insectivorous horseshoe bats also live in the caves. Ominously, Kitum Cave has twice been implicated as the focal point for outbreaks of the deadly Marburg disease, a severe form of hemorrhagic fever caused by a filovirus in the Ebola family, recounted in rather sensationalised form in Richard Preston's book, *The Hot Zone* (1994).

Efforts to identify the vector of the virus, undertaken in the cave in 1987, were unsuccessful, and thousands of people have since visited Kitum Cave without suffering ill effects. Nevertheless, recent research elsewhere has identified the Ebola virus in *Rousettus* bats, so entering the bat roosts is inadvisable. It can also be unpleasant, as the ceilings of the roost are covered in a living mat of blood-sucking riduviid (bed-bug family) *Cimex* bugs! In any case, exploring the bat roosts is highly disruptive to the bats themselves.

The marks left by bushbuck teeth (left) and elephant tusks are clearly identifiable on the cave walls (bottom right). These should not be confused with the marks left by pick axes wielded by humans (top right).

Mount Elgon's underground elephants represent a unique aspect of elephant behaviour that has been learned and passed down over countless generations. That chain was almost broken in the 1980s when intense poaching activity around the caves decimated the herds. Today, the remaining elephants are threatened by the encroachment of farming, which has moved ever higher up the mountain and now straddles the elephants' migration route to the south as they move around the mountain.

Fortunately, the Kenya Wildlife Service has assigned a full-time tracking unit to keep a close eye on the elephants and to intercede in any potential elephant-human conflicts. While the Born Free Foundation in the UK is supporting and bearing much of the cost of the programme, the continued survival of Mount Elgon's remarkable salt-mining elephants will depend on visitor interest and charitable donations.



Further Information

A field guide to the caves, cave maps, and a technical account of the geology and geomorphology of the caves can be downloaded from < http://faculty.jsd.claremont.edu/dmcfarlane/MtElgon/index.htm >.

Information on the Born Free Foundation's work on Mount Elgon is posted on < http://www.bornfree.org.uk/elefriends/elgon.htm >.