# Geology Matters

**December 2020**

## Editorial

My daily reading could best be described as eclectic, although I confess to avoiding Правда, and 解放军报; but I hope that you will not think any the less of me for these omissions. Recently, however, I came across this description of a geologist that I am happy to share with you. Do you recognise yourself?

"There's a little known species called the *geologist* and they are experts at, well, rocks. Some people may have heard of geologists but most will never have seen one as they actually spend much of their time in the wild. Excess facial hair*, large collections of walking boots and the ability to pronounce "greywacke" correctly are all indicators that somebody may actually be a geologist. So what are they and what do they do? They're creatures obsessed with rocks and beer to a level beyond belief. They devote their time to *volcano baiting, fault finding, high-risk colouring* and *rock hunting*, an activity in which the geologist traverses the countryside for miles and miles, risking life and limb, in the hope of locating a "fresh outcrop". A geologist is never more than 50 yards from their geological hammer, but they are not to be confused with geographers whose field weapons are typically blunt clipboards for example and, unlike geographers, geologists do not require assistance tying their bootlaces for a day of fieldwork."

*Except for the equally dangerous female of the species

## But on now to safer ground, or maybe not

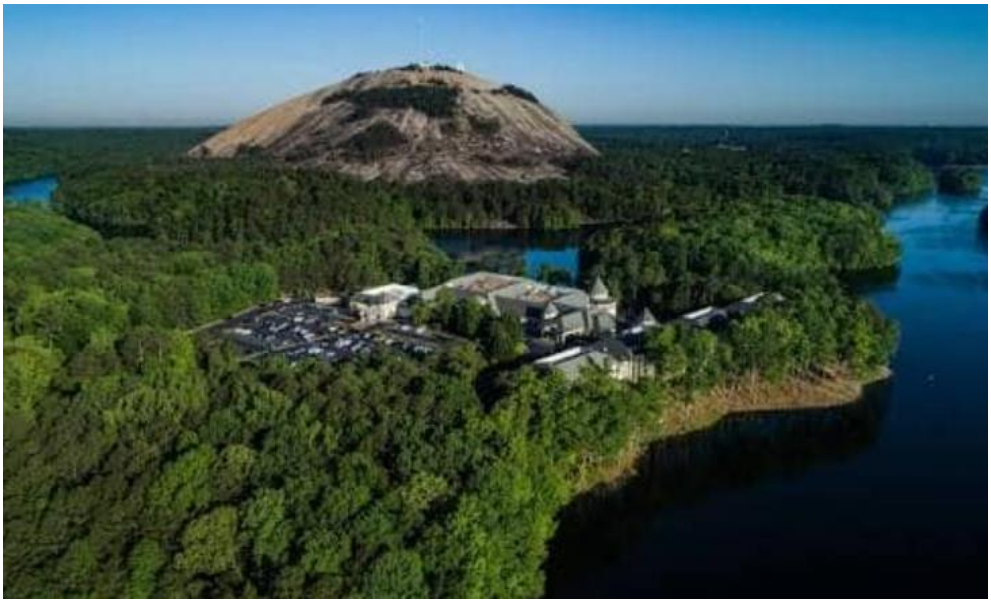
Civil engineers often consult geologists. But not, it seems, always. This is a section of Highway 3 in Taiwan, where it seems the geology has bitten back, so

to speak. The hill had a dip slope on the side nearest the motorway. The other side of dip slopes are steep and irregular, while the slope itself makes it easier for rocks to slide down, experts said.

A dip slope means that the beds in the slope were inclined more or less parallel to the slope surface, creating a plane of weakness on which sliding can occur. The inclination of the beds parallel to this surface on the displaced block is very clear. Excavation of the debris will have to be done very carefully indeed to avoid the up slope material slipping down onto the workers. The lack of a trigger implies a progressive failure – but in this case, oddly, signs of distress were not observed prior to failure.

Finally, it is interesting that the Ministry of Transportation says it is investigating "up to 20 similar dip slopes near major roads in Taiwan". The 18th August 1997 Lincoln Mansions landslide in Taipei, which killed 28 people, was also a dip slope failure, and the 2009 Shiaolin disaster was a wedge failure with a dip slope component. It seems that lessons are not being learned

## Now to something that is pretty stable



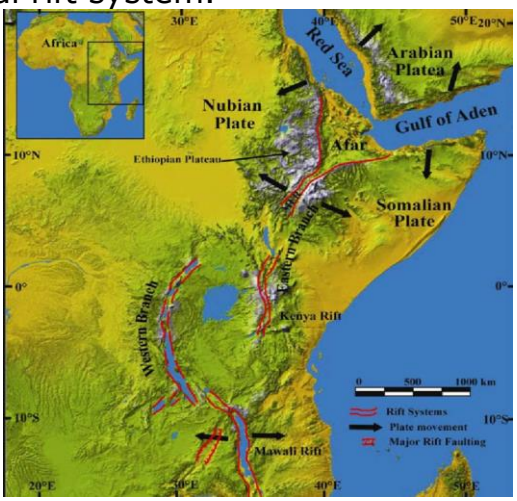
This is Stone Mountain in Georgia, USA; it is an isolated quartz monzonite dome and a pluton, a type of igneous intrusion. Primarily composed of quartz monzonite, but also granite and granodiorite, the dome was formed alongside the Blue Ridge Mountains around 300–350 million years ago, during the Carboniferous era. It formed as a result of the upwelling of magma from within the Earth's crust. This magma solidified to form granite between 10 to 20 Km below the surface. The Stone pluton now continues underground for 14 km. It is interesting to contemplate what has happened to the overlying rock in the intervening period.

## Following up erosion and its consequences

Moving continents now – this time to Africa. We have featured the East African

rift system several times in these pages, but this is a somewhat different take on what is and has been happening.

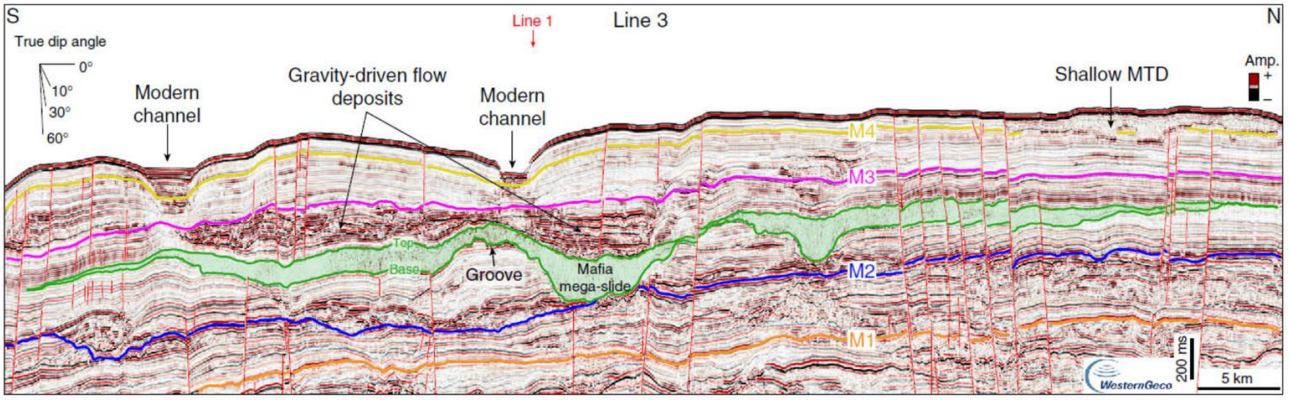
East Africa is traversed from the Afar Depression in the north to Malawi in southern Africa by several great depressions bounded by active normal fault systems or grabens. They are regions of active crustal extension and thinning decorated by chains of active volcanoes. The last 50 years has witnessed more than 3400 major earthquakes (magnitude 4 to 7); unsurprising for the Earth's largest active continental rift system.




In Ethiopia, the rifting began after the whole of the Horn of Africa and Yemen had been smothered by continental flood basalts 30 Mya ago, during the Oligocene Epoch. The East African rifts are repositories for younger sediments that contain a continuous record of hominid evolution from about 5 Mya ago. This is no coincidence, for adjacent bulging of the continental crust resulted both from its unloading by thinning along the rifts and the buoyancy conferred by high heat flow in the mantle beneath. The uplifted areas have risen as high as 4 kilometres elevation (in Ethiopia), and present some of the world's most spectacular land forms. This N-S barrier disrupted earlier climatic patterns that had much of tropical Africa blanketed by dense woodland and resulted in a strongly seasonal climate during the last few million years and the development of open savannah land. Put simply, open grassland with widely spaced trees was no place for diminutive forest apes to scamper on all-fours. Being able to leg-it nimbly on two gave the apes that developed such a gait a decisive evolutionary advantage: the rest, as they say, is human evolutionary history.

The extension and rapid uplift along the rift flanks to this day pose severe risk of landslides. Vast amounts of the upper crust have been stripped off by rapid erosion driven by the uplift. The debris has not only ended-up on the rift floors as sedimentary fill but far more has made its way eastward to be deposited on the Indian Ocean continental shelf. Seismic surveys of the area off Tanzania has revealed one of the biggest landslides on the planet. The Mafia mega slide is represented in seismic profiles by a sedimentary unit, up to 300 m thick. It has a highly irregular base that cuts across strata in late-Oligocene to early-Miocene (25-23 Mya) sediments. It covers an area of more than 11,600 $km^2$ and has a volume of at least 2500 $km^3$. A mass movement of this magnitude would have generated a tsunami larger than that which probably wiped out Mesolithic

habitation on the east coast of Britain 8,200 years ago due to the even larger Storegga Slide at the edge of the Norwegian continental shelf. The Mafia slide event would have flooded wide tracts of the East African coast. Its estimated age, between 22.9 to 19.8 Mya, roughly coincides with the start of volcanism in the Tanzanian segment of the East African Rift and the onset of rifting and uplift of its flanks. It was probably launched by a major earthquake.
Here is the seismic profile of the slide, coloured green (cf high risk colouring).




Now to a more gentle erosive scenario

This is Asia. In fact, the Aktau Mountains (Altyn Emel National Park, Kazakhstan). They are made up of Cenozoic continental sediments: with deposits from the Middle Eocene at the base (Akbulak Formation), from the Oligocene in the middle (Aktau Formation) and from the Oligocene to the late Miocene at the top (ChuI'adyr OIigocene Formation.) These deposits include everything from sandstones and red clays to light quartz sandstones, with interspersed anhydrite and gypsum deposits, with fossil remains of mammals being relatively abundant at some levels. These sediments are relatively poorly consolidated and therefore are susceptible to being easily eroded in the dominant arid climate, forming a

landscape of bad lands.

## Rocks of the month

This one is so rare that not even Margaret Rodway has an example in her otherwise extensive collection.


Sample 76535 from Apollo 17 is a troctolite, a coarse-grained igneous rock that crystallised below the surface of the Moon, but was excavated by later meteorite impact.

And since this in an out-of-world item, here are two related video sequences that are fairly self explanatory.

https://www.youtube.com/watch?v=QunVAWABQSc&feature=youtu.be

and rather briefly

https://youtu.be/LJBv4reH9IU

## And since this is the final edition for 2020

**I WISH ALL OF YOU A VERY HAPPY CHRISTMAS AND A LIBERATED 2021**

## Editorial contact

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