Tracking the hazards and benefits of volcanoes in East Africa

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More than 100 young volcanoes – that have had activity within about 10,000 years – dot the landscape of the East African Rift – an area that runs for more than 3000 kilometres from Djibouti and Eritrea, down

through Ethiopia, Kenya, Uganda and Rwanda to the Democratic Republic of Congo and Tanzania.

This is the place where the African continent is slowly breaking apart at a speed slower than the rate at which human fingernails grow. Steep escarpments and East Africa's deep lakes – like Lake Tanganyika – are the result of this slow spread. It would however still take millions of years before the split occurs.

This process of continental breakup is strongly associated with volcanoes because, as the land splits, molten rock rises into the Earth's crust. Some of this magma makes it to the surface and forms volcanoes.

Most of East Africa's volcanoes are currently dormant. But they could erupt in the future. About 25% of Africa's volcanoes had eruptions in the last 100 years; therefore it's very likely that we will encounter new eruptions in the next few decades.

Sometimes there's very little warning before an eruption, as was the case when Nabro, a volcano near the Eritrean-Ethiopian border, suddenly erupted about seven years ago. There was no ground-based volcano monitoring at the time in Eritrea and the eruption was first observed from space by international scientists. The eruption killed seven people and left 12,000 people homeless. It also disrupted regional air traffic for several days.

To be better prepared for future eruptions there's a need to understand and monitor poorly known volcanoes, even in remote places.

This is what we do. We are part of RiftVolc, a collaboration between scientists from the UK and Ethiopia, focused on understanding volcanism in the main Ethiopian rift, a stretch of 300km covering about 15% of East Africa's volcanoes. We examine past eruptions, the sources

and processes leading to unrest in volcanoes and the potential impact of future eruptions.

Tracking hazards

One way to assess future hazards from long-dormant volcanoes – those with limited or no historical eruptions – is to reconstruct their history using geological records, like rocks and sediment. The landscape around the volcanoes is covered in volcanic rocks that are the result of explosive eruptions that happened over the last 10,000 years. Volcanic ash deposits from these eruptions are also found within sediments in nearby lakes.

This sediment tells us about what has happened in the past – for instance if volcanoes erupted on average every 10, 100 or 1000 years – but also about the style of activity; whether it was lava flows or big explosions. This gives us a good idea of what can happen in the future. Exploration of other volcanoes in the world show that, though every volcano is unique, the general patterns and style of activity tend to repeat themselves. This means that with a better understanding of a volcano's history we can inform policy makers and monitoring agencies responsible for disaster management.

The sequence of volcanic deposits shows that some volcanoes in central Ethiopia, like Corbetti and Aluto, are characterised by between one and four explosive eruptions per millennium. That is up to one every 250 years.

A new eruption from either of these volcanoes would cover several hundreds or even thousands of square kilometres, a size on the order of a thousand football fields, in a blanket of volcanic ash and severely disrupt the local infrastructure and economy, possibly also aviation.

Most volcanoes further north in the Main Ethiopian Rift seem to have

been less active in the last few thousand years, and have mostly had minor explosive eruptions and lava flows. Even such eruptions could however be destructive for local infrastructure.

The geology tells us how damaging a volcano could be and informs what strategies are needed for monitoring and mitigating risk. We can't prevent eruptions, but by better understanding the ones that happened in the past, we can be better prepared for future ones.

Volcanic benefits

Another benefit of tracking volcanoes is that some findings can be useful for completely different reasons.

For example, all over the Main Ethiopian Rift we find places where hot volcanic gases and fluids are emitted. In some places, such steam vents can be used to create thriving resort economies through the creation of spas.

Volcanic fluids can also turn rocks to clay – serving as an excellent source material for ceramics.

And finally the high concentration of active volcanoes in the Rift area provides an advantage in generating geothermal energy – the use of water and steam, drilled from depth, to drive geothermal power generators creating electricity. Significant investment in geothermal energy development on multiple dormant volcanoes, with a total estimated potential of 10,000 MW, is expected to turn Ethiopia into a regional renewable energy powerhouse.

In the short term, the socio-economic benefits associated with the volcanoes far outweigh the risks. But it remains critical to incorporate appropriate strategies towards risk reduction so that the natural resources

offered by volcanoes can contribute to a sustainable future.