

Three dimensional electrical structural of Longonot volcano in the East African Rift Valley and its implications for the formation mechanism of continental rift volcanoes

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SUMMARY

The Great Rift Valley, as the largest fault zone on Earth, is known as the "scar of the Earth" and is one of the areas with the strongest modern extensional activity on Earth. Longonot volcano is located in the central southern part of the East African Rift Valley and is also the latest component of the valley. GPS speed shows that the stretching rate in the area exceeds 7mm/a. There are also multiple large ground fissures in the area, which seriously damage the local infrastructure such as roads. In addition, the area is also extremely rich in geothermal resources. During December 2023, we conducted detailed broadband three-dimensional magnetotelluric research on the Longonot volcano and its surrounding areas, and obtained high-resolution resistivity models. We speculate that the magma system of Longonot volcano rapidly rises diagonally from the asthenosphere mantle to the interior of the crust through decompression and melting, leading to eruption. The continuous upwelling of the magma system also leads to the formation of a large number of surface cracks and a series of secondary geological hazards. These results can not only provide deep geophysical basis for predicting the risk of Longonot volcanic eruption, but also provide inspiration for understanding the mechanism of active continental rift formation. They also indicate that there may be huge geothermal resource potential in the region, which is crucial for Kenya, which lacks electricity and other natural resources.

Keywords: Great Rift Valley; Longonot volcano; Three-dimensional Magnetotelluric; Magma system

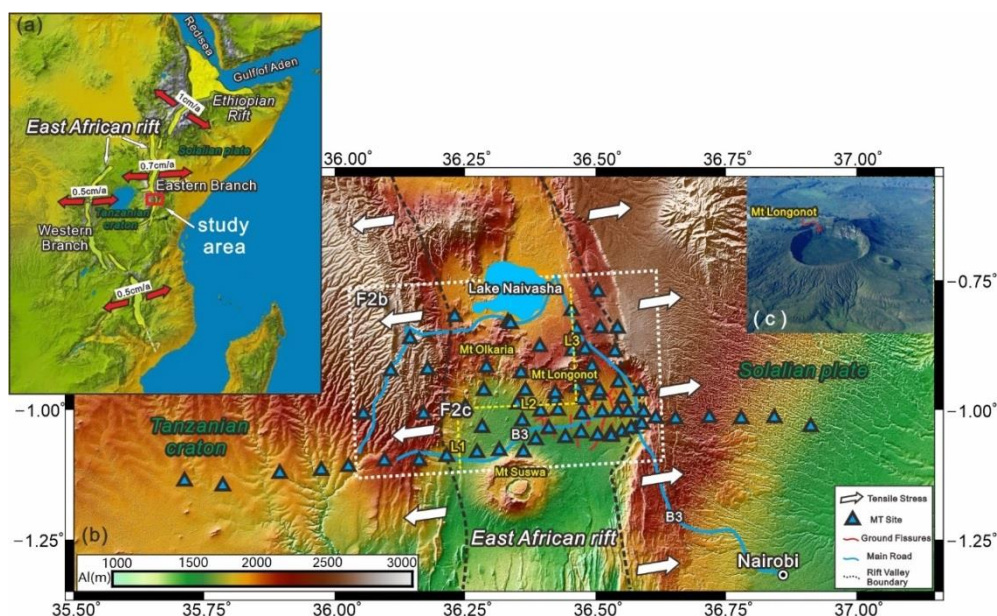


Figure 1. (a) Distribution map of the East African Rift Valley; The red arrow indicates the direction of rift

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movement, and rift movement data is cited from, The red box represents the location map of the research area. (b) The distribution of volcanoes and the location of magnetotelluric survey points in the study area, as well as the surrounding terrain map, are represented by blue triangles. The white dashed box represents the location of Figure 2b, the yellow dashed line represents the positions of the three profiles in Figure 2c, the red line represents the distribution of ground fissures in the study area, and the black dashed line represents the boundary of the East African Rift Valley. (c) Aerial view of Longonot volcano.

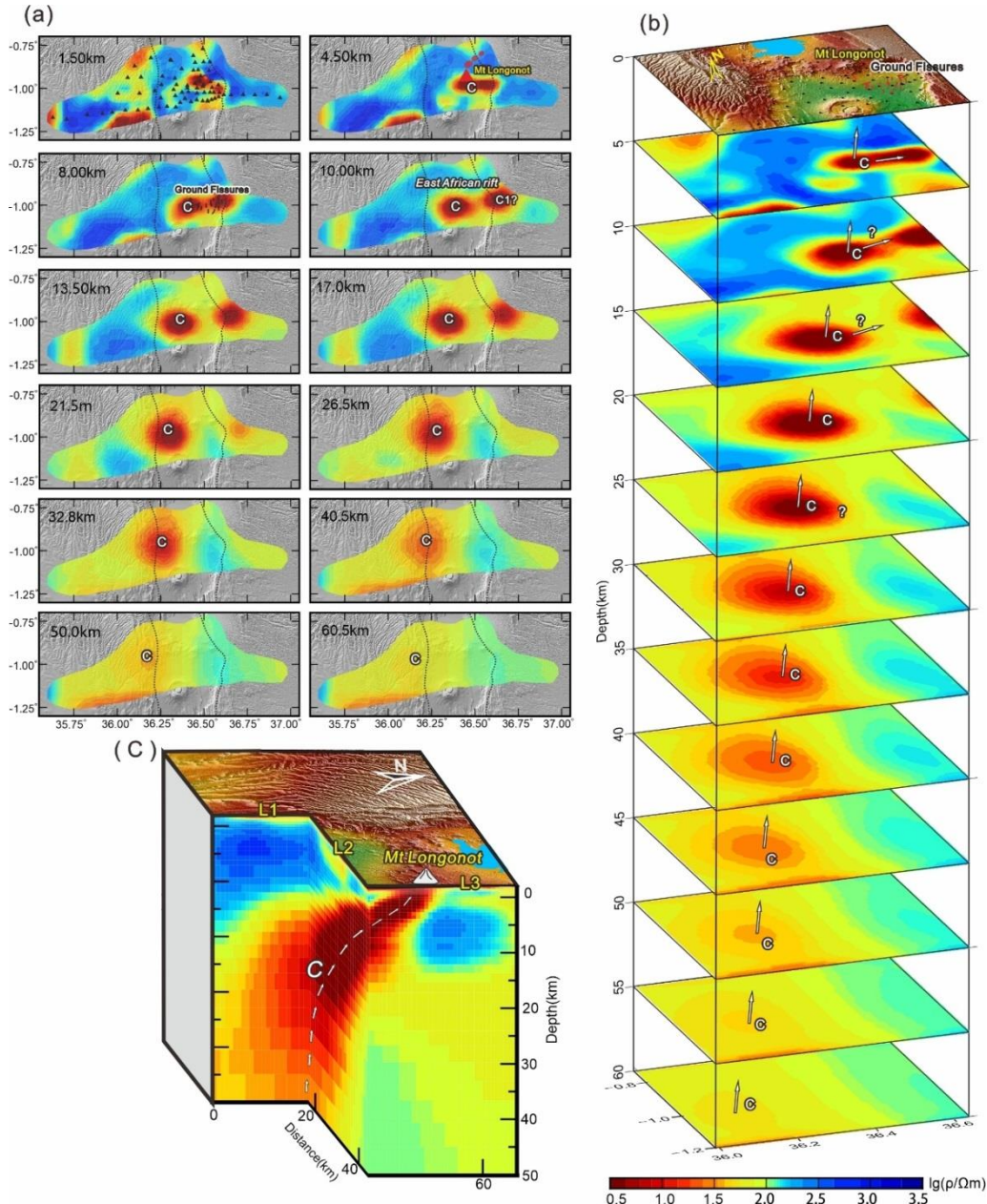


Figure 2. Deep electrical structure diagram, where a represents horizontal slices at different depths (1.5-60.5km) in the MT measurement point coverage area, b represents the core area of the rift valley (as shown by the white dashed box in 1b), and c represents a three-dimensional display of electrical structures in different sections (L1, L2, and L3 are shown by the yellow dashed line in Figure 1b)