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The geomorphology, structure and lava flow dynamics of peralkaline rift volcanoes from high-resolution digital elevation models

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High-resolution digital elevation models enable observation and comparison of the geomorphology and structure of large and inaccessible volcanoes. We present topographic data for three peralkaline volcanoes in the Main Ethiopian Rift (Fentale, Corbetti and Gedemsa) and one volcano in the Afar Rift (Dabbahu). In combination with field observations, the data reveal previously unidentified post-caldera deposits and craters. Vent and crater locations are aligned with rift-parallel faults and also with rift-cutting structures in a variety of orientations. Caldera shape is also controlled by interaction with these structures. The relative frequency and type of eruption varies greatly between volcanoes over the past 150 kyr with Gedemsa largely inactive, Fentale hosting deposits from many small volume eruptions (< 0.1 km^3) and Corbetti having produced several large eruptions ($\sim$0.4–0.5 km^3). The frequency of basaltic eruptions at volcanic centers is higher in the north of the rift compared to the south, where silicic activity is more frequent. Morphometry of peralkaline rhyolite deposits at Corbetti and Fentale, including ogives and levees, suggest emplacement viscosities ($\sim 10^8$–10^{11} Pa s) similar or lower than calc-alkaline rhyolites, consistent with experimental and theoretical studies. The observations presented here have significant implications for hazard assessment in the rift and highlight a number of questions regarding rift volcanism, including the importance of structural features in controlling the location, magnitude and style of activity.