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Contemporary volcanic hazards in the Main Ethiopian Rift

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The Main Ethiopian Rift (MER), the northernmost segment of the eastern branch of the East African Rift System, is the type example of a mature continental rift, where strain is accommodated by magmatic intrusion into distinct magmatic segments [1]. In this study we focus on the central MER (~7-9 °N), which includes regularly spaced silicic caldera complexes and central stratovolcanoes on the rift axis, as well as large fields of small eruptive centres, predominantly scoria cones of basaltic composition. The main centres, from North to South, are Fanta'Ale, K'one, Boset-Berecha, Gedamsa, Bora-Berecha, Aluto and Corbetti. This range of central on-axis volcanoes is obliquely dissected by the Wonji Fault Belt which controls the spatial distribution of the majority of the small eruptive centres [2].

The recent history of active volcanism at the central MER volcanoes is poorly known, but important to assess contemporary volcanic hazards and associated risk. We present a compilation of existing literature data, geomorphological and field observations, and new geochemical data on tephra deposits from the main centres of Late Quaternary volcanic activity in the central MER, and discuss the most recent styles of activity at each, with implications for contemporary volcanic hazards. Our observations show that the large caldera systems have displayed highly contrasting eruptive behaviour in their post-caldera stages, despite highly similar chemical composition of the magmas and similar tectonic controls.

Most central MER volcanoes host large calderas, some up to 15km in diameter. The eruptions that formed these calderas, mainly between 150 and 300 ky ago, have generated widespread ignimbrite flow sheets of trachytic to rhyolitic composition. Post-caldera activity is dominated at all centres except K'one and Fanta'Ale by effusive and explosive eruptions of peralkaline rhyolitic magmas, which have generated obsidian flows and domes and pumice cones within the old calderas. Corbetti and Aluto have both been highly active in the Late Quaternary, as evidenced by the presence of numerous volcanic ash layers in lacustrine sediment cores spanning the last 12,000 years [3], and multiple pumice fall deposits on their edifices. Post-caldera activity at Gedamsa has also generated pumice cones but much less frequently, with only three distinct eruptive events. At K'one and Fanta'Ale, post-caldera activity is dominated by small-scale basaltic lava flows and scoria-cone-building eruptions which may largely be controlled by the Wonji Fault Belt.

Our results suggest that the potential volcanic hazards and risks at the central MER silicic caldera systems vary widely between each complex, despite strong similarities in their general structure and long-term evolution. A thorough evaluation of volcanic hazard and risk in this part of the East African Rift System should therefore be performed against detailed studies on each centre individually.

References:

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