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Tectonic evolution, volcano-tectonic architecture, geothermal systems and geo-hazards in the Rungwe Volcanic Province (East African rift, SW Tanzania)

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The present-day volcano-tectonic architecture of the Rungwe Volcanic Province (RVP) at the intersection between the Eastern and Western branches of the East African rift system in the SW highlands of Tanzania is the product of a long-term rift evolution into several successive stages. The Neotectonic period in that area represents the second – and still active stage of the Late Cenozoic rifting history, and is constrained by dated volcanics from the Rungwe massif, to have started 1.5 - 1 Ma ago.

A detailed investigation combining SRTM DEM90, referenced aerial photographs, topographical and geological maps and field observations allow to refine the knowledge of the tectonic architecture and fault kinematics. The RVP is currently affected by a strike-slip to extensional type of tectonic stress regime with both horizontal ENE-WSW maximum compression and NNW-SSE minimum compression (extension) axes. Deformation localises mainly along high-angle faults that cross-cut the whole volcanic massif and along which significant strike-slip to oblique-slip movements occur. These faults often reactivate older basement structures and/or normal fault systems within Late Quaternary rift sediments and volcanics. They exert a strong control on the volcanic vent location and also on the discharge of many hydrothermal

springs (hot springs and CO2 gas vents, depending of the hydrothermal system).

The locations of at least two of the three largest volcanic centers, i.e. Ngozi and Rungwe –are also controlled by tectonic lineaments. Volcanic vents are mostly restricted to the rifts' center. Three vent clusters can be recognized, two of which are associated with the main volcanoes. According to the watershed geometry, location of major Quaternary volcanoes and tectonic architecture, at least two major geothermal systems can be identified. Both present mantle isotopic signatures in the analysed gas, suggesting that they are related to active magma chambers at depth. Recent field work supplemented by geochemical and isotopic analysis show that this geothermal system is definitely fault controlled.

As the RVP region is densely populated and provides a major contribution to the food supply of Tanzania, a better knowledge of the tectonic structure is important not only in terms of geothermal potential and CO2 degassing, but also for geo-hazards.