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Thermal mapping: the hydrothermal system of a volcano used to map faults and palaeostructures within stratified ground. The Yasur–Yenkahe volcanic complex (Vanuatu)

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Subsurface thermal measurements provide a valuable tool to map hydrothermal-fluid release zones in activevolcanic areas. On explosive volcanoes, where ash fall layers deposit parallel to the ground surface, hydrothermal fluids are trapped in the stratification due to the variations in permeability in deposits of the different explosive phases. Thermal fluids thus travel parallel to the surface close to the ground. This horizontal flux can only escape when faults break the seals of stratification.

On the Yasur–Yenkahe volcanic complex (Tanna Island, Vanuatu archipelago), fumaroles andhot springs abound, signs of upraising heat fluxes associated to a well-developed hydrothermal activity. Combinationof high resolution mapping of ground thermal anomalies with geomorphological analysis allows thecharacterization of the structural relationships between the active Yasur volcano and the Yenkahe resurgent dome.

A complex system of heat release and hydrothermal fluid circulation below the Yasur–Yenkahe complex isevidenced. Circulation, though propagating vertically as a whole, is funneled by stratification. Thus, the main thermal fluid release is almost exclusively concentrated along structural limits that break the seals inducedby the stratified nature of the ground. Three types of medium/high temperature anomalies have beenevidenced: (1) broad hydrothermalized areas linked with planar stratification that favor lateral spreading,(2) linear segments that represent active faults, and (3) arcuate segments related to paleo-crater rims.

Thelimit between the Yasur volcano and the Yenkahe resurgent dome is characterized by an active fault systemaccommodating both the rapid uplift of the Yenkahe block and the overloading induced by the volcanoweight. In such a setting, faults converge below the cone of Yasur, which acts as a focus for the faults. Evidenceof such structures, sometimes hidden in the landscape but detected by thermal measurements, iscritical for risk assessment of flank landslides.