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Rift zone reorganisation and flank collapse on Fogo (Cape Verdes): New constraints from cosmogenic ^{3}He exposure dating

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Rift zones are prominent structural features on volcanic ocean islands (e.g. Hawaii, Canary Islands and Reunion) and exert a strong control on intrusive and extrusive volcanism and island morphology. Volcanic ocean island rift zones often show a three-armed geometry. Continued intrusion along these rift zones can result in magma overpressure; horizontal expansion develops along the dyke system whereas vertical drag occurs perpendicular to the rift axis. When these stresses eventually exceed the stability threshold, volcano flanks fail, generating large flank collapses (e.g. La Palma, Tenerife, Hawaii). Observations from flank collapses on Hawaiian and Canary island volcanoes demonstrate that the sliding blocks consistently form between two branches of the triple-armed rift system. Understanding the relation between rift-zones and flank collapses is often hampered by lack of absolute age constraints on the duration and timing of the processes that lead to flank instability. This is in part is due to the difficulty of obtaining accurate ages of young basaltic rocks. Charcoal for radiocarbon dating is not always preserved and often rocks are to young to be dated accurately by ^{39}Ar/^{40}Ar.

Here we present cosmogenic 3He results to date rift zone magmatic reorganisation and the lateral flank collapse of the Monte Amarelo volcano. Pre-collapse volcanic activity occurred along a W-E trending rift zone. Prior to the collapse this rift zone

was abandoned and volcanic activity moved to NNE–SSW and NW–SE trending rift zones. The post-collapse history of the Cha das Caldeiras volcano has seen similar structural reconfiguration of dyke swarms and eastward shift of volcanism resulting in the extinction of post–collapse volcanic rift zones in the west of the island. Cosmogenic ^{3}He exposure ages of seven post-collapse flows have exposure ages ranging from 62 to 11 ka. The analysis of multiple flow tops on each lava flows, often at different elevations, provides an internal check for age consistency and the exposures ages appear to conform well to the relative stratigraphy. The exposure ages suggest that volcanic activity along the western branch of the triple-armed rift zone has been nearly continuous from before 62 to approximately 11 ka. The absence of magmatic activity for the last 11 kyr reflects a structural reconfiguration of the volcano and is probably related to renewed flank instability. The ^{3}He exposure age of one pre-collapse flow is 121.6 ± 3.1 ka and brackets the timing of collapse between 62 – 122 ka. The youngest volcanic hiatus is similar in onset and duration to that observed in for example the Canary Islands (La Palma) and suggests that regional factors could play a role. The resolution of the timing of the collapse is insufficient to attribute it to, for example, global sea level changes related to glacial maxima.