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Exploring the links between volcano flank collapse and magma evolution: Fogo oceanic shield volcano, Cape Verde

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Mass wasting of oceanic shield volcanoes is largely documented through the recognition of collapse scars and submarine debris fans. However, it is actually difficult to infer the mechanisms controlling volcano flank failures that potentially imply tens to hundreds of km^3. Studies coupling detailed petrological and geochemical analyses of eruptive products hold clues for better understanding the relationships between magma sources, the plumbing system, and flank instability. Our study aims at tracking potential variations of magma source, storage and transport beneath Fogo shield volcano (Cape Verde) before and after its major flank collapse. We also provide a geochronological framework of this magmatic evolution through new radiometric ages (K-Ar and Ar-Ar) of both pre-collapse and post-collapse lavas.

The central part of Fogo volcanic edifice is truncated by an 8 km-wide caldera opened to the East, corresponding to the scar of the last flank collapse (Monte Amarelo collapse, Late Pleistocene, $\sim$150 km^3). Lavas sampled at the base of the scar (the so-called Bordeira) yielded ages between 158 and 136 ka. The age of the collapse is constrained between 68 ka (youngest lava flow cut by the collapse scar) and 59 ka (oldest lava flow overlapping the scar). The collapse walls display a complex structural, intrusive and eruptive history. Undersaturated volcanism (SiO_2<43%) is surprisingly dominated by explosive products such as ignimbrites, with 4 major explosive episodes representing half of the volume of the central edifice. This explosive record onshore is correlated with the offshore record of mafic tephra and turbidites (Eisele et al., 2015).

Major elements analyses indicate that the pre-collapse lavas are significantly less differentiated than post-collapse lavas, with a peak of alkalis at the collapse. Rare-earth elements concentration decreases with time, with a notable positive anomaly before the collapse. The evolution of the isotopic ratios (Sr, Nd and Pb) through time displays unusual V-shaped profiles centered around the collapse. The occurrence of the Monte Amarelo collapse is thus not disconnected from the magmatic evolution, both at the crustal and mantellic levels. Our results also point out the importance and relative frequency of explosive eruptions of undersaturated magmas at Fogo volcano.