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Internal architecture of the two-fold nature Monte Amarelo volcanic flank-collapse deposit offshore Fogo Island in the southern Cape Verdean Archipelago

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Volcanic islands are the sites of some of the largest submarine landslides observed on Earth. Individual landslide deposits can contain several hundreds to few thousands of cubic kilometers of mobilized material and, therefore, represent significant hazards. They can generate destructive tsunamis which may have devastating impacts on coastal areas and populations. Hazard potential of volcanic flank-collapses is widely recognized, but the magnitude, and therefore the hazard potential of tsunamis triggered by such collapses have been much debated over the past decades. Hence, a better understanding and a full characterization of volcanic landslide deposits and emplacement dynamics is crucial. Fogo Island, situated in the southern part of the Cape Verdean Archipelago, is one of the most active oceanic intraplate volcanoes in the world. Fogo Volcano experienced a catastrophic flank-collapse event as witnessed by up-to-1 km high, eastward-opened horseshoe-shape depression. Tsunami deposits found on the nearby islands of Santiago and Maio indicate that the flank-collapse was tsunamigenic *(Ramalho et al. 2015; Madeira et al. 2019)*. To better constrain the tsunamigenic hazard potential of this large, volcanic flank-collapse, we collected in 2019 a dense network of marine geophysical datasets offshore Fogo. Our dataset includes high-resolution multi-beam swath bathymetry, parametric sediment echo-sounder, multi-channel seismic reflection, sidescan sonar data and sediment gravity cores. Here, we present the key results of the seismic data. We show – for the first time – the internal architecture of the Monte Amarelo flank-collapse deposit in unprecedented detail. Our data reveal a two-fold nature of the deposit with hummocky terrains in the proximal area – typical of blocky debris avalanche deposits – and finer-grained, acoustically transparent deposits in the southern distal part. Our observations support recently-proposed failure models, where the loading of seafloor sediment by volcanic debris avalanche deposits triggered sediment destabilization and progressive downslope-propagating failure along a décollement surface *(Le Friant et al. 2015, 2020)*. The basal surface of the Monte Amarelo deposits along with a series of strong internal reflections have also been

captured in the seismic data, both in the proximal and distal part. This suggests a multi-phase event in the emplacement of the Monte Amarelo deposit offshore and allows us to reassess the volume of failed and remobilized material. Such details are particularly unusual on submarine volcanic flanks, as it is rather difficult to image the base of debris avalanche deposits due to their hummocky nature that instantly diffract/scatter the acoustic energy. This makes Fogo's Monte Amarelo volcanic flank-collapse deposit a perfect study case to investigate the emplacement dynamics of large-scale, volcanic flank collapses and better constrain their tsunamigenic hazard potential.