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Morphological evidence of a large collapse on the north-western flank of Gran Canaria (Canary Islands)

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Flank collapse has largely influenced the morphological evolution of the Canary Islands. Bathymetry and geophysics have been used in the past to identify such events, which have been linked to sub-aerial structures. However, these efforts have been limited by the quality of the reworked submarine morphologies and the difficulty in justifying a number of sub-aerial features. Here we analyse the on-shore morpho-structural features of the northwest coast of Gran Canary island where a flank collapse has been identified. This coast is dominated by a broad 20 km-wide and 5 km-deep re-entrant and its landward side is characterized by a >1000 m-high cliff with a gradient of 45º. In an attempt to through light on the nature and mechanism of flank failure we study the extent of the affected zone, the estimated volume of the on-shore deposit and an age constraint of the two large slump blocks that run parallel to the coastal platform.

The roughed steep coastal profile is cut by several small collapses. The cliffs define a boundary between the inland valleys and the coastal strip. Cartography shows an anomalous hydrologic drainage system, a disparate bedding dip and a range of tectonic structures. The dissymmetric river drainage system shows parallel geometry on the seaside catchment; formed by few, shallow steep gullies. The inland catchment is hierarchical with a rectangular geometry and gully incisions are deeper, the coastal cliff truncates the head of the drainages and river channels form abrupt turns to merge into the main system. Substrate materials are products of the first cycle of activity in the Miocene; a monotonous succession of basaltic lava flows conformably overlaid by trachyrhyolitic lavas. The series shows a despair dip: to the northwest for the western sector and sub-horizontal or lightly to the southeast for the rest. Several families of partially nested normal faults that run sub-parallel to the coast cut this stretch of coast. These fractures show a strong seaward dip and comprise metric scale breccias, show hectometric displacement on the vertical and offset dikes horizontally on a metric scale.

These anomalies have been attributed, in the past, to a supposed volcanic centre located to the west on what is now offshore, that would have been active during the initial island shield phase and the Fataga stratovolcano. This Miocene age volcanic centre would have then collapsed. This hypothesis requires the coastal margin to be extended to the northwest excessively. Here we present a much simpler hypothesis to explain the described morphologies, with the activity occurring at an inland volcanic edifice with an initial dip of the series to the northwest, by assuming a rotational component on the displacement of the blocks forming the head of the flank collapse, as observed at other island rock slides. This way the sub-horizontal dips of the series that crop out on the cliffs is accounted for. Theses beds would show an apparent dip opposite to the fault plane. Therefore, this area comprises the proximal sector of a landslide that is slightly offset from the vertical by a translational movement.