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Felsic lavas of Terceira Island, Azores: distribution, morphology and mode of emplacement

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Terceira Island in the Azores archipelago is a remarkable example of effusive felsic volcanism. It is located in a geodynamic setting dominated by the WNW-ESE slow-spreading Terceira Rift that separates the Eurasian and Nubia plates, east of the Mid-Atlantic Ridge. Terceira differs from the other islands of the archipelago for the abundance of peralkaline felsic domes and coulees, which are the product with the largest volumetric expression (4.1 km^3 DRE) in the recent eruptive history of the island ($<$ 20 ka). These lavas fill and overflow the calderas of Pico Alto and Santa Bárbara volcanoes, but also occur along the flanks of the two volcanoes.

Morphological, morphometric and geological analysis provided the means to constraint the emplacement modes of these peralkaline felsic lavas. From the spatial distribution of the eruptive centres it was possible to determine the presence of extensive WNW-ESE, NW-SE and ENE-WSW alignments, suggesting that these lavas were fed from depth by dykes strongly influenced by regional stress fields, although sometimes locally subjugated by magmatic stress.

Lavas from both volcanoes are peralkaline trachytes and comendites very uniform in appearance with black, scoriaceous, rubbly surfaces, ranging from almost aphyric to porphyritic. They show surface morphologies typical of viscous magmas such as ogive-like rigdes, convex in the direction of flow, high levees, lava channels and spines. The lava domes are 14-183 m in height, with radius of 50-372 m, ranging in volume from $7x10^4$ to $4x10^7$ m^3. Coulees can reach lengths in excess of 2800 m, with widths ranging from 110 to 900 m and thicknesses of 15-70 m. The calculated volumes range from about $3x10^5$ to 10^8 m^3.

The morphometric analysis indicate that domes follow a geometrical growth pattern of low domes (H = 0,36R), dominated essentially by an endogenous regime, although exogenous growth involving extrusions of small lobes is also present. This suggests a low magma viscosity at time of extrusion, compatible with the yield strengths ($3x10^4$ - $7x10^5$ Pa) and plastic viscosities ($3x10^7$ - $7x10^{10}$ Pa.s) estimated and the peralkaline nature of these magmas. The low correlations observed between the morphometric parameters of the coulees suggest a more complex emplacement. The transition from dome to coulee may result from the increase of the effusion rate or the failure of one side of the dome allowing lava to flow downhill. As the lava supply becomes exhausted levees develop in the coulee by drain-out of the central part.