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Eruption, deposition and geometry of peralkaline ignimbrites on Terceira, Azores: The case of the Lajes-Angra Ignimbrite Formation

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Ignimbrites are relatively uncommon on ocean island volcanoes and yet they are found on three islands of the Azores. Terceira has a stratigraphic record of at least seven major ignimbrite-bearing formations dated between 86 and 21 ka, which makes it the Azorean island with the greatest erupted volume of ignimbrite. These ignimbrite formations can result from a single eruption or, more often, from a few events closely-spaced in time, in which case, they are composed of members. Ignimbrites on Terceira share similar features, including mildly peralkaline compositions and lithofacies, suggesting that the processes involved in the ignimbrite-forming eruptions are recurrent in the last 86 ky. The Lajes-Angra Ignimbrite Formation is the youngest (∼21 ka) and one of the largest ignimbrite formations on Terceira. This formation is associated with Pico Alto volcano and includes two members: The Angra Ignimbrite (0.08 km^3 bulk volume), restricted to one valley on the south of the island, is a monotonous ignimbrite (8 m thick on average) with a high aspect-ratio of 1:500 and is almost totally composed of non-welded massive lapilli-ash. The Lajes Ignimbrite (0.59 km^3 bulk volume) extends to the northern and southern coastlines and floors low-lying ground around the volcano. This ignimbrite (3.5 m thick on average) has a low aspect-ratio of 1:8600 and shows vertical and lateral lithofacies variations. The typical sequence starts with a thin crystal-rich bed, overlain by massive ash that grades into fine-grained massive lapilli-ash (frequently welded). It gradually passes upward to non-welded coarser grained massive lapilli-ash, which occasionally exhibits diffuse-stratified or diffuse-bedded lithofacies. Lateral variations range from lapilli-ash-dominated lithofacies (frequently welded) in palaeovalleys to thin weathered massive ash (crystal-enriched) over reliefs. Juvenile pumice and dense vitrophyric clasts from both ignimbrites are comenditic trachyte in composition (65.1-66.3 wt% SiO_2, 1-1.12 Peralkalinity Index) and have the same mineral assemblage dominated by alkali-feldspar. Within the constraints of the available ages and stratigraphic relations, the Angra and Lajes ignimbrites are interpreted to record two ignimbrite-forming eruptions of Pico Alto that occurred closely-spaced in time. The Angra Ignimbrite eruption was characterized by a short-lived pyroclastic fountain that formed a small-volume sustained pyroclastic density current mostly channelled along a valley to the south. The Lajes Ignimbrite eruption was marked by prolonged pyroclastic fountaining that generated a sustained quasi-steady pyroclastic density current that spread radially from Pico Alto caldera. The absence of associated pumice fall layers and breaks within the deposits suggest that no stable eruptive columns were formed and that the ignimbrites record single depositional units. Despite sharing the same composition and comparable eruptive dynamics, the different geometry (aspect-ratio) and lithofacies architecture of the two ignimbrites are interpreted to result from differences in the erupted volumes, influence of palaeotopography and current behaviour.