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Welded and unwelded pyroclastic dykes of the Sierra Madre Occidental, Mexico, and Las Cañadas caldera, Tenerife

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A large variety of pyroclastic dykes have been observed and mapped at the Sierra Madre Occidental (SMO) ignimbrite province of Mexico and the Las Cañadas caldera (LCC) of Tenerife, Spain. The dykes show the following characteristics: i) either completely welded, partially welded (agglutinated), or unwelded, ii) a matrix made up by pumice-lapilli or ash, or both including fiammé depending on the degree of welding, iv) stark variations in lithic as well as crystal contents, v) size range from over 200 m width to as thin as a few cm, vi) variety of leaching and/or quenching features from the margins to interior, viii) fiammé are aligned vertically or subvertically, ix) shearing along margins and wall-cooking and x) either tabular, lense-like, or irregular shapes. The dykes appear to have formed by several (composite) or single emplacement pulses with or without evidence for magma-mingling. In summary their structural and textural architecture is as complex and varied as seen in ignimbrites. This complexity results from the interaction of many factors including magma chamber as well as emplacement processes. Detailed knowledge on how these dykes are formed is still lacking, but we believe that a detailed investigation of such dykes may shed light on the physical and chemical processes that were involved in their formation. Dykes at the SMO are clearly related to a tectono-volcanic regime that produced major fault and graben systems during Basin and Range extensional episodes in the mid-Tertiary. The

SMO dykes were emplaced during fissure-type explosive volcano-tectonic eruptions that produced about 400,000 km3 of silicic ignimbrites. A single dyke of the SMO can be several kilometers long and tens of m wide, but in most cases, they occur as discontinuous, lense-shaped, smaller dykes (tens of m long by a few m wide). However, these smaller dykes form dyke sets up to 50 km long that follow the main trend of the faults. The pyroclastic dykes of the Las Cañadas caldera form part of the cone-sheet dyke system of the caldera. They are mainly observable in the caldera wall. At both SMO and Tenerife dykes can be clearly associated with co-ignimbrite lithic-lag breccias confirming that these pyroclastic dykes were feeding explosive ignimbrite volcanism, despite pronounced differences in tectonic, magmatic and stress conditions in either environment. Our working hypothesis to explain the observed features is that these dykes are emplaced from an evolved magma chamber that reaches to shallow crustal levels and is evacuated when normal faults (SMO case), or caldera collapse ring faults (Tenerife case), reach the roof of the chamber, causing rapid decompression due to the opening of the system. As a result voluminous highly differentiated magmas (rhyolitic in the SMO, compared to phonolitic in Tenerife) are erupted explosively through these faults. The fissures are filled by the pyroclastic material and then sealed after cooling producing the observed pyroclastic textures of the dykes. In the SMO case the pyroclastic dykes are tectonically controlled and follow the regional fault trend, whereas at the LCC they follow the ring fault system.