Growth and destruction by lateral collapse of the Roque Nublo oceanic island stratovolcano, Gran Canaria, Canary Islands.

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The Roque Nublo volcano developed from about 5.5 Ma to 2.7 Ma on the island of Gran Canaria. Its growth followed an erosional hiatus after the end of intense volcanic activity of Miocene age (ca. 14.5 Ma to 8.5 Ma) in which the island first formed. It is therefore post - erosional in the Hawaiian sense, and had a lower eruption rate than most shield - building volcanoes. However, the Roque Nublo volcano had a much higher eruption rate than is typical of post - erosional volcanism. It therefore has many of the characteristics of shield - building oceanic island volcanoes, including development of a summit crater complex fed by a differentiated shallow magma system, a stratovolcano - type geometry and repeated lateral collapses.

The Roque Nublo Group, representing the products of the volcano, is divided into a number of formations (see key to Fig. 1). The oldest of these, the El Tablero formation, represents the first stages of post - erosional activity (from 5.5 to 4.6 Ma) before development of the stratocone. It consists of a number of monogenetic strombolian cones and lava flows scattered over the island, and so is more typical of post - erosional activity than the late activity. The main stratovolcano contains three extracrater formations, which form its flanks. These are the Riscos de Chapin (ca. 4.6 to 3.9 Ma; basanite and alkali basalt to trachyte and phonolite lavas with mino intercalated pyroclastic and epiclastic deposits); Tirajana (ca. 3.9 to 3.0 Ma; mainly pyroclastic and epiclastic rocks, with minor intercalated lavas); and Tenteniguada (ca. 3.9 to 2.7 Ma; phonolitic plugs and domes partly coeval with the other units) formations. The Riscos de Chapin formation represents an early effusive period of activity of the volcano, whilst later activity became almost entirely explosive, resulting in the rocks of the Tirajana formation. These two formations show strong radial variations (Figs. 1 & 2). The Riscos de Chapin lavas vary from entirely basic near the periphery of the volcano to a well - developed basaltic to trachytic differentiation sequence at the centre. The epiclastic rocks of the Tirajana formation (sediments and laharic breccias) are also found on the lower slopes of the volcano, whilst Tirajana formation sequences in the medial and proximal area are dominated by lithic - rich ignimbrites (see Pérez Torrado et al., *Genesis of the Roque Nublo Ignimbrites Gran Canaria, Canary Islands*, this volume for detailed discussion of these deposits). The Rincon de Tejeda formation represents an early intracrater sequence and consists of lacustrine sediments, lag breccias and agglutinates intruded by alkali gabbro plugs and a radial dyke swarm. The central area of the island also contain a number of younger extrusive and intrusive units, emplaced between the lateral collapses which affected the volcano: these are discussed below.

Unlike the continuous sequences characteristic of shield - building activity, the Roque Nublo Group contain within it a number of unconformities. These are especially prominent in the west and south of the island where intense pre - Roque Nublo erosion of the Miocene volcanic rocks produced a mountainous terrain with severa large canyon systems. These canyons, particularly the Barranco de Tejeda in the west and the Barranco de Tirajana in the south - east, were re - incised repeatedly during the growth of the Roque Nublo volcano and may have influenced its morphology and structural evolution.

In the later stages of its growth the Roque Nublo volcano underwent a series of lateral collapses to the south and west. The slopes of the volcano were steeper on these sides than in the north and east, probably as a result o erosion along the canyon systems originally formed in the Miocene, as noted above. Thus the directions o instability of the volcano may have been controlled by pre - existing drainage systems. The deeply - eroded remnants of debris avalanche deposits from these collapses occur as far south as the coast near Arguineguin, 25 km away from the source region (García Cacho et al., 1987, 1994; Mehl & Schmincke 1992), and as far west a the Mesa de Junquillo, 15 km from the source. The collapse structures themselves developed near the summit o the volcano and are partly preserved in the deeply - eroded region around Ayacata. The internal structures of the collapses are well - exposed in this region and provide much evidence regarding collapse mechanics. Detailed mapping has revealed that three collapse episodes occurred, separated by periods of erosion, edifice growth and intrusion emplacement, and pre - collapse deformation representing incipient instability. The mapping has also revealed the age relationships of the collapses to the in situ formations of the volcano. The previously - defined Ayacata formation (Pérez Torrado et al. 1995), defined as consisting of all the debris avalanche deposits, i therefore abandoned and the different debris avalanche units assigned member status within the other formations.

The first collapse produced massive, chaotic breccias: the Pargana member of the Tirajana formation. These, represent two or more relatively slow - moving viscous debris flows composed of homogenised, water - saturated matrix - rich breccia with blocks up to 1 km across. The unit also contains many peperitic basalt intrusion emplaced during and after debris flow movement. The Pargana member is limited in extent, indicating that the debris flows probably only reached several kilometres from the source. Much of the Pargana member was subsequently deformed and further displaced in the second and third collapses.

The second and third collapses, the Timagada and Montana del Aserrador collapses, are represented in the Ayacata area only by widespread occurrences of fault rocks and gouge breccia mtrusions, but can be correlated with debris avalanche deposits to the south and west by occurrences in the deposits of clasts from different groups of intrusions in the deposits. The debris avalanche deposits are therefore named the Timagada member o the Tirajana formation and the Montaña del Aserrador member of the El Montañon formation (see below). Each collapse seems to have begun with coherent sliding of blocks up to kilometres across on discrete fault surfaces Recognisable summit intrusive complexes of brecciated gabbro and porphyry, emplaced between the collapse episodes, occur within these collapse structures. These intrusive complexes have been transported south and west by distances of several kilometres by sliding on the basal fault surfaces of the collapses. Patterns of movement of the fault blocks, and marked asymmetry of the Timagada collapse structure in particular, have been deduced from slickenlines and tool marks on the fault surfaces. Only the lower parts of these block - sliding domains arq preserved in the Ayacata area; the upper parts appear to have disaggregated to form the debris avalanches.

After the Timagada collapse, deep erosion in the headwall region of the Barranco de Tejeda was followed by a resumption of activity within the collapse scar, producing the El Montanon formation which fills a palaeocanyon system. This formation generally resembles the proximal facies of the Tirajana formation, being dominated by lithic - rich ignimbrites with interbedded felsic agglutinates, epiclastic breccias and lavas. It can be correlated using clast populations in the ignimbrites with groups of intrusions in the Ayacata area, and may also be equivalent to the younger Tenteniguada domes and plugs to the east. The depth of the erosion (over 500 m) i, particularly remarkable in that age constraints indicate that the interval between the Timagada and Montaña de Aserrador collapses is a few hundred thousand years at most. Re - growth of the volcano must have also occurred in this interval. Both the rapid erosion and the subsequent collapse to the west are considered to reflect the importance of the pre - existing and repeatedly re - established Barranco de Tejeda canyon system.

References

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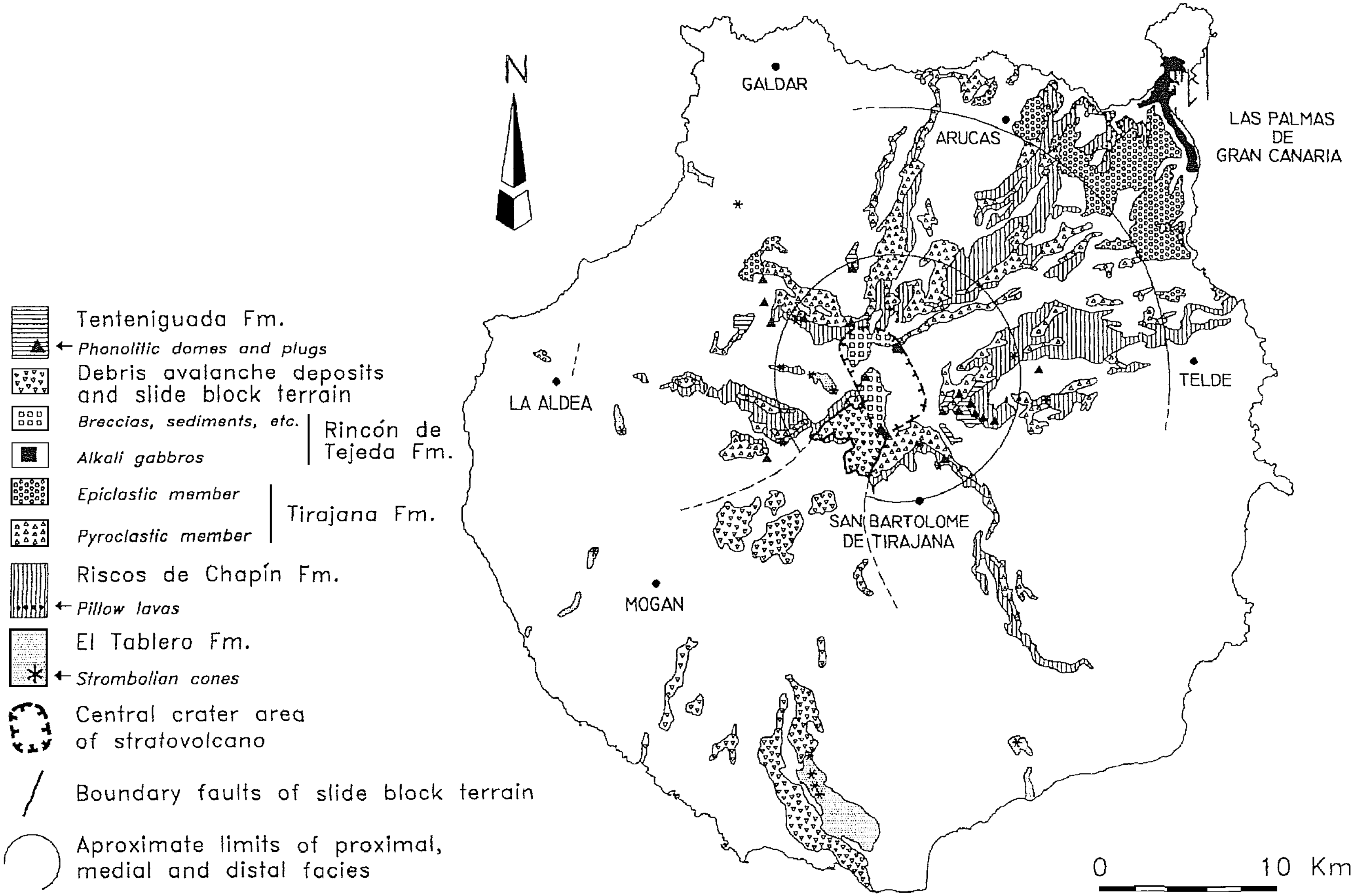

Figure 1.- Simplified map of the Roque Nublo group.

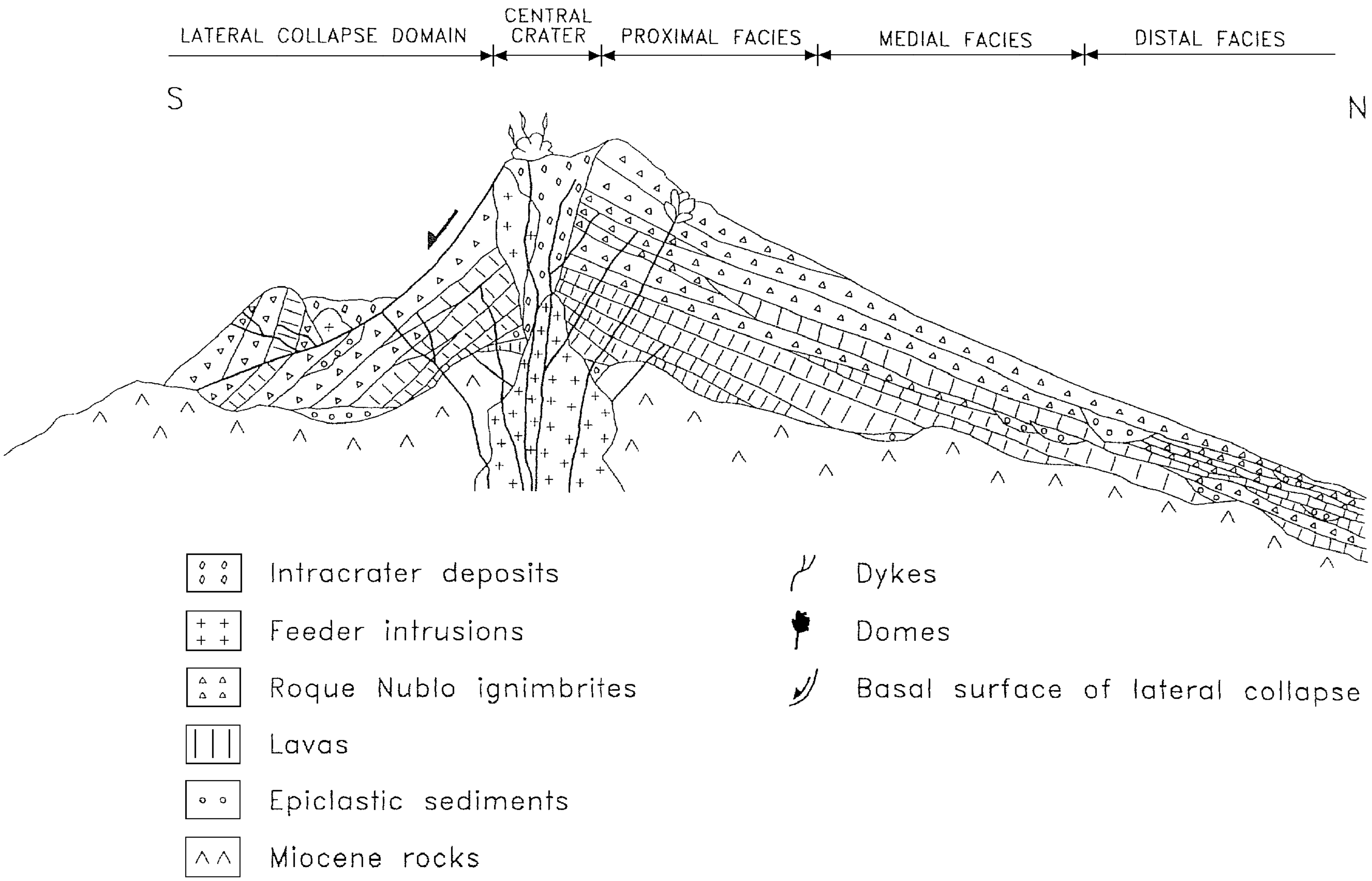

Figure 2.- Schematic cross – section through the Roque Nublo stratovolcano at a late stage in its development.