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A new chronostratigraphical and evolutionary model for La Gomera: Implications for the overall evolution of the Canarian Archipelago

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Abstract

A review of the general volcano-stratigraphy and geochronology of La Gomera, one of the lesser known Canary Islands, has led to the establishment of a new evolutionary model. The oldest edifice corresponds to the submarine stage built up between 20 and 15 Ma. The construction of the Submarine Edifice was followed by an important break in the activity (about 4 Ma) and deep erosion of the edifice. About 10.5 Ma ago, the main present-day edifice (the Old Edifice 10.5–6.4 Ma) emerged, which was also submarine in its initial phases. Two different main stages are distinguishable. The first stage was represented by a large, some 22 km wide basaltic shield volcano (the Lower Old Edifice). Several lateral collapse events (Tazo and San Marcos avalanches) occurred during this time and were responsible for the removal of an important part of its northern flank. In the second growth stage (the Upper Old Edifice), the activity migrated southwards. A 25-km wide composite volcano arose covering part of the remaining earlier shield volcano. The felsic (trachytic to phonolitic) activity occurring in two separate episodes formed a significant component of this composite volcano. Finally, one more recent large edifice (the Young Edifice) built up from 5.7 to 4 Ma. The lava flows of this younger edifice covered completely the centre and the south of the island and filled deep ravines in the north. More evolved magmas, including significant felsic magmas (the third and last felsic episode), occurred in this phase of activity.

The growth of La Gomera was long-lasting, separated by an important gap in the activity in the Middle Miocene, with no Quaternary activity at all. At the same time on Tenerife (the nearest island east of La Gomera), three large edifices grew separately: Roque del Conde, Anaga and Teno (initially three separated islands). From the available data, it is inferred that the subaerial activity started earlier in the Roque del Conde Edifice, then on La Gomera and later in Teno in the NW and Anaga in NE of Tenerife, which is the youngest of all these edifices. These facts, together with the irregular general progress of the volcanic activity, support more complex views of the genesis for the Canary Islands than the simple hotspot model.

Keywords: La Gomera; volcanic edifices; K/Ar geochronology; Canary Islands; oceanic islands; hot spot; lateral collapse; seamount

1. Introduction

The island of La Gomera, 380 km^2 in surface area, is one of the minor western islands of the Canarian Archipelago (Fig. 1). The island is round and has a diameter of 24 km with a maximum height of about 1500 m in the central area. The geological

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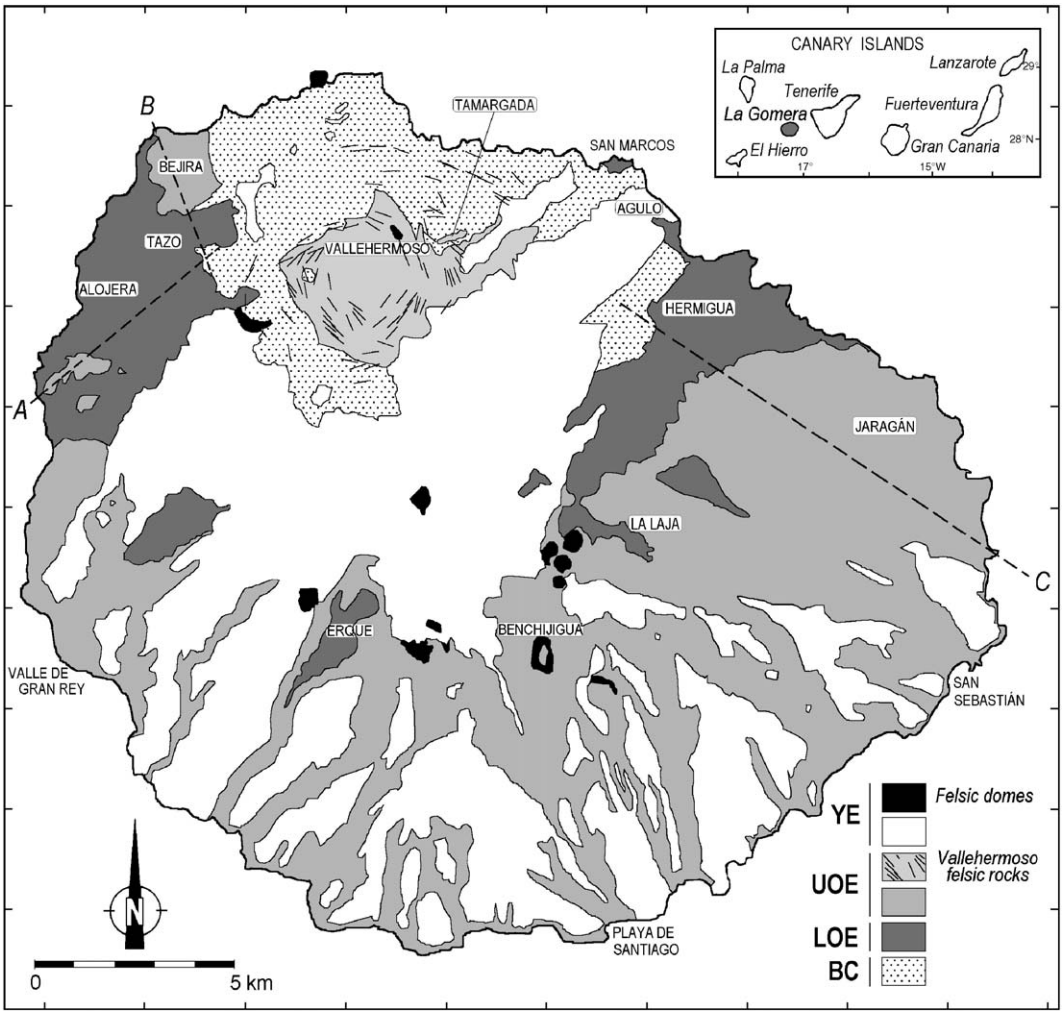

Fig. 1. Simplified geological map of main stratigraphical units of La Gomera. A, B and C cross-section in Figs. 3 and 4.

characteristics differ from those of the two other minor islands in the vicinity, La Palma and Hierro, due to the much older age of La Gomera and its lack of Quaternary activity. This makes La Gomera exceptional since it is the only island that can be considered non-active in spite of its location near the "young" end of the chain.

On the other hand, the temporal evolution of the volcanic activity on each one of the Canary Islands has always been an important key in the understanding of the archipelago, from the early models of Wilson (1973), Morgan (1971) and Anguita and Hernán (1975), to the most recent of Araña and Ortiz (1991), Hoernle and Schmincke (1993), Carracedo et al. (1998), Anguita and Hernán (2000), Geldmacher et al. (2001) and Guillou et al. (2004).

The existence of the oldest known volcanic materials on one of the easternmost islands (Fuerteventura) and the much younger age of the two westernmost (La Palma and Hierro) was the main initial argument to interpret the Canary Islands as a linear trace left by a mantle plume, while the African Plate moved eastwards. The model was almost immediately criticized by Anguita and Hernán (1975) who emphasized the lack of regularity in the age decrease across the chain and, very specially, the existence of anomalous several million years long gaps in the activity in some of the islands. In this context, a more precise knowledge of the volcanic history of La Gomera is required.

Due to its small size and the lack of recent activity, La Gomera is less well known in geological terms than the other islands. The first relatively modern general works that defined the main units of the island are those of Bravo (1964) and Hausen (1971). Later, Cendrero