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# New data (U–Pb, K–Ar) on the geochronology of the alkaline-carbonatitic association of Fuerteventura, Canary Islands, Spain

Mercedes Muñoz[a,*], Juana Sagredo[b], Cristina de Ignacio[c], Javier Fernández-Suárez[a], Teresa E. Jeffries[d]

[a]*Departamento de Petrología y Geoquímica, Fac. CC. Geológicas, Universidad Complutense, 28040 Madrid, Spain*
[b]*Instituto de Geología Económica, CSIC, Universidad Complutense, 28040 Madrid, Spain*
[c]*Departamento de Matemáticas, Física aplicada y Ciencias de la Naturaleza, Universidad Rey Juan Carlos, C/Tulipán s/n, 28933, Móstoles, Madrid, Spain*
[d]*Department of Mineralogy, The Natural History Museum, London SW7 5BD, United Kingdom*

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**Abstract**

Zircons from a nepheline-syenite of the Fuerteventura Basal Complex were dated by Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS). The age obtained from a total of 21 U–Th–Pb analyses is $25.4 \pm 0.3$ Ma ($2\sigma$) indicating a late Oligocene–early Miocene crystallization. This age is consistent with new K–Ar ages on nepheline-syenites and pyroxenites, and contradicts previously published $^{39}Ar$–$^{40}Ar$ (feldspar) ages that were interpreted to represent a late Cretaceous–early Paleocene, pyroxenitic–syenitic magmatic episode. These new geochronological data are consistent with both field observations and most of the previously published ages on alkaline silicate rocks and associated carbonatites of Fuerteventura. Therefore, they strongly support the existence of a single, late Oligocene–early Miocene event of alkaline–carbonatitic magmatism in the Basal Complex of Fuerteventura, taking place at approximately 25 Ma and comprising: alkaline-pyroxenites, melteigites-ijolites, nepheline-syenites and carbonatites, as well as their volcanic equivalents and associated dykes.

These new data provide an estimate for the length of time that it took the island to grow, thus eliminating one of the major problems in explaining its development by a hot-spot model.


*Keywords:* Canary Islands; Fuerteventura; Syenite; LA-ICP-MS; Zircon

## 1. Introduction

The Canary archipelago is peculiar in that intrusive rocks cropping out in three of its islands (Fuerteven-

* Corresponding author. Fax: +34 915442535.
*E-mail addresses:* fuertm@geo.ucm.es (M. Muñoz), sagredo@geo.ucm.es (J. Sagredo), cignacio@escet.urjc.es (C. de Ignacio), jfsuarez@geo.ucm.es (J. Fernández-Suárez),

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tura, La Gomera and La Palma) represent the roots of different volcanic edifices, providing a unique opportunity to study the process of growth and evolution of these islands. The intrusive rocks belong to the so-called Basal Complexes in each island, among which the Basal Complex of Fuerteventura is the oldest. One of the controversial issues concerning the evolution of Fuerteventura is the age of the onset of the magmatism with which the growth of the island started and hence the onset of magmatism in the Canary archipelago. According to some authors this magmatism would have begun by the late Cretaceous–early Paleocene (Robertson and Stillman, 1979; Le Bas et al., 1986; Balogh et al., 1999), involving an approximately 65 Ma span of igneous activity in the island of Fuerteventura. In turn, for other authors (Fúster et al., 1980; Cantagrel et al., 1993; Sagredo et al., 1996) the activity would have started during the Oligocene and therefore, the development of the island would have taken place over the last 35–30 Ma. These different ages were obtained in rocks belonging to the oldest intrusive episode of the Basal Complex of Fuerteventura, which comprises alkaline ultramafic rocks to nepheline-syenites and carbonatites, and gave rise to a discrepancy concerning the number of episodes of carbonatites and associated alkaline silicate rocks in the island. With the purpose of solving this discrepancy about the age of the alkaline-carbonatitic magmatism in Fuerteventura, we review previously published ages on the Basal Complex alkaline silicate rocks, carbonatites and associated dykes and present: Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) U–Pb ages of zircon from a nepheline-syenite as well as K–Ar ages of a nepheline-syenite and two clinopyroxenites from the central-western sector of the Basal Complex, where the oldest ages (63–64 Ma) have been reported for nepheline-syenites (Balogh et al., 1999). The obtained ages, which are discussed in the context of geological relationships, largely contribute to clarify the above mentioned discrepancy and have important implications on the growth and development of the island.

## 2. Geological setting

The Canary archipelago is composed of seven islands, of which the easternmost, Lanzarote and Fuerteventura lay out in a NE–SW trend, roughly parallel to the African continental margin, and at approximately 100 km offshore the Moroccan coast. In the island of Fuerteventura, three main units can be differentiated, from older to younger: the Basal Complex, the Miocene volcanic edifices, and the Pliocene–Quaternary volcanics (Fig. 1). The Basal Complex, exposed in the western part of the island, is composed of: oceanic sediments of Mesozoic and Cenozoic age, volcanic materials, and several kinds of intrusions, as well as a dense dyke swarm crosscutting most of these materials. The different kinds of intrusions, which are related to different kinds of dykes and volcanics, can be grouped in the following episodes (Muñoz et al., 2003): 1) a submarine volcanic episode (EVS) that represents the submerged growth stage of the island; 2) an alkaline-carbonatitic event, EM1, comprising alkaline pyroxenites, melteigites-ijolites, nepheline-syenites and carbonatites and hydromagmatic volcanics of similar composition. This episode represents the transition between the submarine and subaerial growth stages of the island; 3) a mafic–ultramafic, EM2 event of transitional composition, comprising pyroxenites and gabbros and equivalent volcanics; 4) a third magmatic event, EM3, represented by the alkaline gabbros and syenites of the Vega de Río Palmas Complex and; 5) an EM4 event, represented by the volcanic–subvolcanic edifice of Betancuria. The volcanic rocks belonging to the EM2, EM3 and EM4 events represent the subaerial growth stage of the island.

The EM1, alkaline-carbonatitic intrusive rocks crop out in an almost continuous, NE–SW fringe in the western part of the island, comprising two main sectors: the northwestern, Montaña Blanca-Esquinzo sector, and the central-western, Ajui-Solapa sector (Fig. 1), this work being mainly focused on the latter. These alkaline-carbonatitic rocks are intrusive in the submarine volcanic episode (EVS) and are considered by the authors as the roots of dismantled volcanic edifices of equivalent composition (Muñoz et al., 2002). In turn, the EM1 alkaline-carbonatitic rocks are intruded by the EM2, mafic–ultramafic rocks, mainly represented by the Pájara pluton in the Ajui-Solapa sector. This pluton, emplaced along transtensive, dextral shear zones (Muñoz et al., 1997), produces a contact metamorphic aureole in the EM1 rocks and dykes.