New 40Ar-39Ar geochronological data at two areas of interest in the Anaga massif (Tenerife): Punta Poyata and Igueste de San Andrés. Some implications

Nuevos datos geocronológicos 40Ar-39Ar en dos puntos singulares del macizo de Anaga (Tenerife): Punta Poyata e Igueste de San Andrés. Consecuencias de interés

J.A. Rodríguez-Losada[1,2], M. Ferrer [3,2], L. González de Vallejo[4,2], J. Martínez-Frías[5,2] and L.E. Hernández-Gutiérrez[1,2]

1 Dpto. de Biología Animal, Edafología y Geología. Universidad de La Laguna. 38206 La Laguna. Tenerife. Email: jrlosada@ull.edu.es
2 Instituto Volcanológico de Canarias (INVOLCAN). Parque Taoro 22. 38400 Puerto de La Cruz. Tenerife
3 Instituto Geológico y Minero de España. Ríos Rosas 23, Madrid
4 Universidad Complutense de Madrid. J. Antonio Novais, 2. Madrid
5 Instituto de Geociencias, IGEO (CSIC-UCM), Facultad de C.C. Geológicas, C/ José Antonio Novais, 2, Ciudad Universitaria 28040 Madrid (Spain)

Resumen: En este trabajo se aportan nuevos datos geocronológicos Ar40-Ar39 en rocas ancaramíticas submarinas localizadas en dos puntos singulares del macizo de Anaga (NE de Tenerife): las ancaramitas submarinas hidrotermalizadas de Punta Poyata (NNW de Anaga) y las lavas submarinas ancaramíticas del Barranco de Igueste (SE de Anaga). Las muestras estudiadas pertenecen a afloramientos pertenecientes a los niveles estratigráficos más inferiores de la secuencia volcánica que conforma el edificio de Anaga. En Punta Poyata se tomaron dos especímenes que dieron edades de 12,2 ± 1,9 Ma and 13,0 ± 1,0 Ma. En el barranco de Igueste los resultados geocronológicos de las muestras tomadas dieron edades de 12,7 ± 1,6 Ma and 9,7 ± 1,0 Ma. Estos datos sugieren que el macizo de Anaga comenzó su desarrollo subaéreo antes de lo que anteriormente se creía, ajustándose dicho período inicial al Mioceno Medio en lugar de al Mioceno tardío como previamente se asumía.

Palabras clave: Ar40-Ar39, Punta Poyata, Igueste, Tenerife, datos geocronológicos.

Abstract: *This work provides new Ar40-Ar39 geochronological data in submarine ankaramite rocks located in two distant points of Anaga (NE Tenerife): the submarine hydrothermally altered ankaramites of Punta Poyata area (NNW Anaga) and the ankaramitic pillow lavas at Barranco de Igueste (SE Anaga). The studied samples were collected from outcrops of the lowest stratigraphic levels throughout the volcanics that build up the Anaga massif. At Punta Poyata, two collected samples yielded an age of 12,2 ± 1,9 Ma and 13,0 ± 1,0 Ma. At Barranco de Igueste, sample results are of 12,7 ± 1,6 Ma and 9,7 ± 1,0 Ma. These data support the assumption that the Anaga massif began its subaerial growth earlier than that previously was supposed, most likely in the Mid-Miocene Instead of late Miocene as currently believed.*

Key words: *Ar40-Ar39, Punta Poyata, Igueste, Tenerife, geochronological data.*

BACKGROUND

The Anaga massif is located at the northeastern end of Tenerife Island. There, three volcanostratigraphic series were identified, separated by unconformities about 7 and 4 Ma. The series were called as Lower, Middle and Upper Series (from the most ancient to the most recent one). The Lower Series is formed by a complex sequence of alkali basalts and layers of volcanoclastic breccias and piroclastic deposits cut by dykes and domes of mafic and felsic compositions. At the base of the Lower Series, outcrops in the north, as an arcuate landform, the so called "Arco de Taganana". From this area, Abdel Monem et al. (1972) obtained a 16.1 Ma age for an ankaramite sample. This dating could not be confirmed by further research and therefore it was considered questionable in later works. Most papers point to a range of ages about 8 to 3 Ma for the subaerial evolution of Anaga Massif (Carracedo, 1975; Féraud, 1985; Ancochea et al., 1990; Thirlwall et al., 2000; Walter et al., 2005).

With the limitations imposed by the conditions and varying alteration degree of rock samples, two rocks of ankaramitic nature have been dated by 40Ar-39Ar: one from a pillow lava flow located in the ravine of Igueste southeast Anaga and another from lavas with hydrothermal alterations and mineralization processes in submarine conditions located towards the northwest Anaga (Fig. 1).

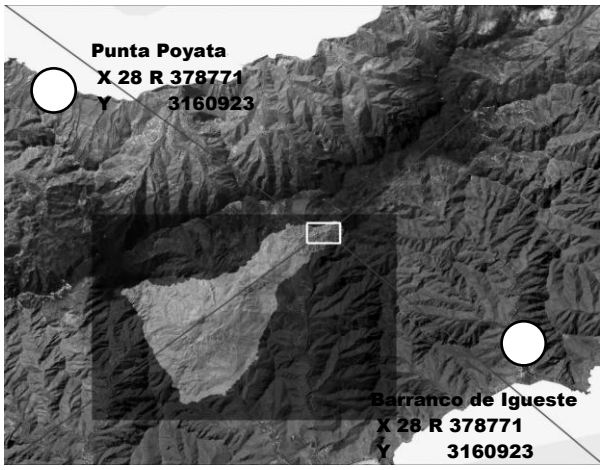

FIGURE 1. *Location of the selected samples with UTM coordinates.*

RESULTS

The analytical procedure was applied to the whole rock. Selected samples were sent to Activation Laboratories in Canada for geochronological dating by 40Ar-Ar39 method. The main challenge was finding an appropriate sample with minimal alteration degree. Fresh samples representing the initial stages of growth of Anaga massif, are practically unavailable. That caused a lack of data about the age of the most ancient outcrops in the massif. In this work, new 40Ar-39Ar data help to fill this void. The data results yielded an age of 12,2 ± 1,9 Ma and 13,0 ± 1,0 Ma at Punta Poyata and 12,7 ± 1,6 Ma and 9,7 ± 1,0 Ma for the samples collected from the Barranco de Igueste (TABLE I) .

SAMPLE	TFA (Ma)±1σ	WMPA (Ma)±1σ
Poyata-1	n.d.	12,2±1,9
Poyata-2	13,9±0,7	13,0±1,0
Igueste-1	15,3±1,1	12,7±1,6
Igueste-2	10,47±0,69	9,7±1,0

TABLE I. *Obtained ages of the collected samples. TFA: total fusión age (apparent age). WMPA: Weighted mean plateau age. N.d.: no data available*

.

BRIEF DISCUSSION AND IMPLICATIONS

In the light of the obtained data, it can be observed certain discrepancy between the apparent age obtained by total fusion of the samples and plateau ages obtained by step heating, discrepancies attributable to the fact of having been a certain mobilization of Ar on the studied rocks. In this sense, it is assumed here that the plateau age represent a value closer to the true age of the outcrops than that obtained from the total fusion of the samples. The discrepancy presented by the two types of determinations is very small in Poyata-2. Igueste samples show a greater discrepancy between the total fusion age and the plateau age and between the two samples with a maximum age of 15.3 Ma Igueste-1 and 10.47 Ma in Igueste-2. This discrepancy decreases significantly in their plateau values of 12.7 Ma and 9.7 Ma. For Anaga massif, the oldest age obtained in the northflank was that given by Abdel Monem (1972), over an ankaramite rock which was dated of 16.1 Ma. Our data are close to those obtained by Abdel Monem on the northern flank of Anaga and we can conclude that the lowest levels of Anaga are aged at least 13 Ma. In the south, although more uncertain, it is estimated that the value of 15.3 Ma obtained by total fusion overestimates the actual age of the sample, consequently the plateau ages of 12.7 Ma and 9.7 Ma are considered closer to the real age. As final conclusion, the most significant implication is that the ages of the lowest levels of Anaga massif reduce the uncertainty of the lower limit of Anaga which is more clearly defined as Mid-Miocene.

REFERENCES

Abdel-Monem, A., Watkins, N. D. and Gast, P. W. (1972): Potassium-argon ages, volcanic stratigraphy, and geomagnetic polarity history of the Canary Islands; Tenerife, La Palma and Hierro. *American Journal of Science*, 272(9): 805-825.

Ancochea, E., Fuster, J., Ibarrola, E., Cendrero, A., Coello, J., Hernan, F., Cantagrel, JM. and Jamond, C. (1990): Volcanic evolution of the island of Tenerife (Canary Islands) in the light of new K-Ar data. *Journal of Volcanology and Geothermal Research*, 44(3): 231-249.

Carracedo JC (1975): *Estudio paleomagnetico de la isla de Tenerife.* PhD thesis, Univ Complutense de Madrid, 265 p.

Féraud, G., Giannérini, G., Campredon, R. and Stillman, C.J. (1985): Geochronology of some Canarian dike swarms: contribution to the volcano-tectonic evolution of the archipelago. *Journal of Volcanology and Geothermal Research*, 25(1): 29-52.

Thirlwall, M. F., Singer, B. S. and Marriner, G. F. (2000): 39 Ar–40 Ar ages and geochemistry of the basaltic shield stage of Tenerife, Canary Islands, Spain. *Journal of Volcanology and Geothermal Research*, 103(1): 247-297.

Walter, T. R., Troll, V. R., Cailleau, B., Belousov, A., Schmincke, H. U., Amelung, F. and Vd Bogaard, P. (2005): Rift zone reorganization through flank instability in ocean island volcanoes: an example from Tenerife, Canary Islands. *Bulletin of Volcanology*, 67(4): 281-291.