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ALKALINE AND CARBONATITIC INTRUSIVE COMPLEXES FROM FUERTEVENTURA (CANARY ISLANDS): RADIOMETRIC EXPLORATION, CHEMICAL COMPOSITION AND STABLE ISOTOPE.

J. Mangas[1]; F.J. Pérez-Torrado[1]; R.M. Reguilón[2] and A. Martín-Izard[3]

[1] Dept. of Geology, Univ. of Las Palmas, 35017 Gran Canaria, Spain.

[2] Dept. of Geology, Univ. of Salamanca, 37008 Salamanca, Spain.

[3] Dept. of Geology, Univ. of Oviedo, 33005 Oviedo, Spain.

GEOLOGICAL SETTING.- Two main geological units are present on Fuerteventura: the Basal Complex (C.B.) and the later subaerially-erupted volcanic group. The C.B. is made up of turbidity sediments of Lower Cretaceous, breccia and submarine lava flows, and Miocene alkaline plutonic rocks. Volcanic rocks are mainly basaltic lava flows and pyroclasts, and dykes, formed between Miocene and to the present time. Referring to the plutonic alkaline rocks there are two intrusive episodes containing ultamafic (pyroxenites, etc), mafic (gabbros, etc) salic (ijolites, syenites, etc) and carbonatitic rocks, which constitute: a) the Puerto de la Peña-Cueva de Lobos complex formed approximately 60 m.y. ago, b) the Esquinzo complex emplaced some 30 m.y. ago and situated to the north of the island (Fig. 1).

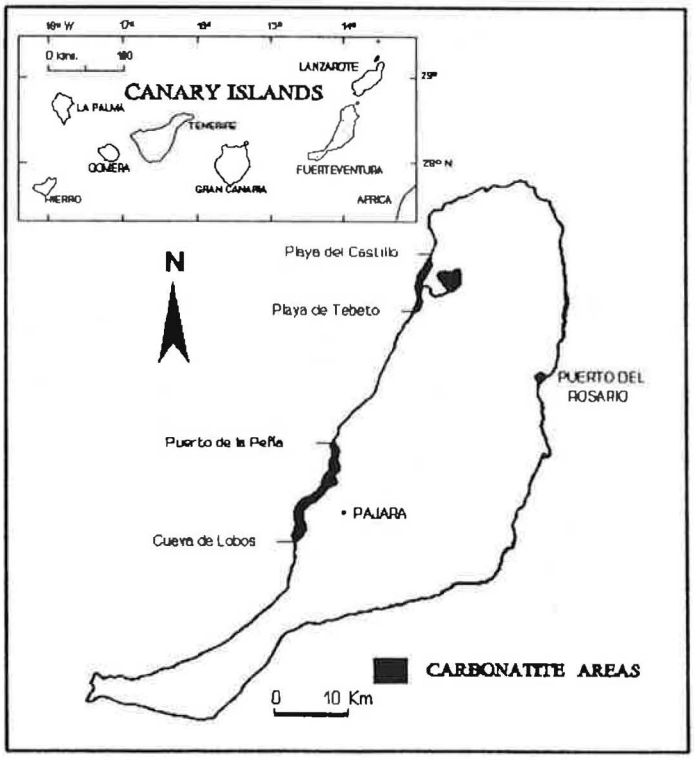

Figure 1 - Situation of alkaline and carbonatitic complexes.

The different petrological facies which these complexes are composed maintain between them a close genetic relation and on the outcrop level present the following characteristics: a) apophisis of decametric dimensions and veins of metric and centimetric sizes appear distributed at random, many times

anastomosated, with no defined directions and with no morphologic continuity due to the fact that they are crossed by a thick mesh of later dykes which can occupy the 95% of the outcrop; b) show bad-defined contacts, with gradual and/or light diffused limits, sometimes assimilation structures between differents bodies can be observed; c) migmatitic, breccia and zoned structures; d) textures from aphanitic to pegmatitic in the same body or adjacent bodies; e) sometimes they present metasomatism and fenitization processes and f) these rocks are covered by basaltic and recent sedimentary materials which difficults the study of same.

RADIOMETRIC EXPLORATION.- A radiometric exploration cruise took place in these two complexes as a guide of the REE prospection, using a scintillameter and a portable gamma ray spectrometer. The values (c/s) obtained in the different geological formations of the areas studied are the following: 1) regional background (50); 2) C.B: a) cretaceous sediments (40-50); b) submarine breccia and lava flows (30-50); c) vein complex (30-200); d) mafic and salic breccia (20-120); e) alkaline and carbonatitic complexes: pyroxenites, amphibolites y gabbros (20-60), ijolite-syenite series (50-450), carbonatites (50-820); and f) rocks of other plutonic intrusive episodes: werhlites, pyroxenites, amphibolites and gabbros (20-60), syenites and trachites (50-230); 3) post C.B. formations: a) basaltic pyroclasts and lava flows (20-40) and b) recent sediments (20-50). Thus, syenite-ijolite series and carbonatitic rocks show up as radiometric anomalies of the headwaters of Agua Salada ravine in the northern zone and of the areas between Punta Nao-Caleta Mansa, Punta de Gaspar González-Punta Viento and Punta Peñon Blanco-Risco Blanco, in the western centerpoint of the island.

CHEMICAL COMPOSITION AND MINERALOGY.- More than 70 chemical analysis have been made (ICP, XRF and INAA) of all the rocks of which these complexes are composed, and their maximum and minimum results of ΣREE in ppm are the following: 1) Esquinzo complex, mafic rocks (116-236), syenites (54-1,041), ijolites (51-1,227) and carbonatites (511-4,974); 2) Puerto de la Peña-Cueva de Lobos complex: ultramáfic (184) and mafic (330-357) rocks, syenites (60-1,761), ijolites (246-2,290), carbonatites (697-7,372). The carbonatites contain the highest contcentration of REE, with the relation LREE/HREE being high (Fig. 2), being calciocarbonatites (sövites and alvikites) and their concentrations in other chemical elements are similar to those described by Woolley and Kempe (1989) for carbonatites in other parts of the world.

From the mineralogical point of view these carbonatites are composed essentially of calcite, as accessory minerals apatite, ore minerals, aegirina, K feldspar, sphene, biotite, hornblende, allanite, perovskite, garnet, nepheline y zircon appear, and as secondary minerals epidote, sericite, clhorite and albite. Ore minerals are mainly magnetite and ilmenite, and in a lesser proportion pyrite, chalcopyrita, pyrrhotite, sphalerite, hematite, chalcocite, covellite and goethite. The REE may be associated with the carbonates (calcite), phosphates (apatite), silicates (allanite, sphene, zircon and epidote), and oxides and hydroxides (perovskite and goethite), between other minerals. Actually, analysis of electronic microprobe are being carried our on all the paragenesis minerals.

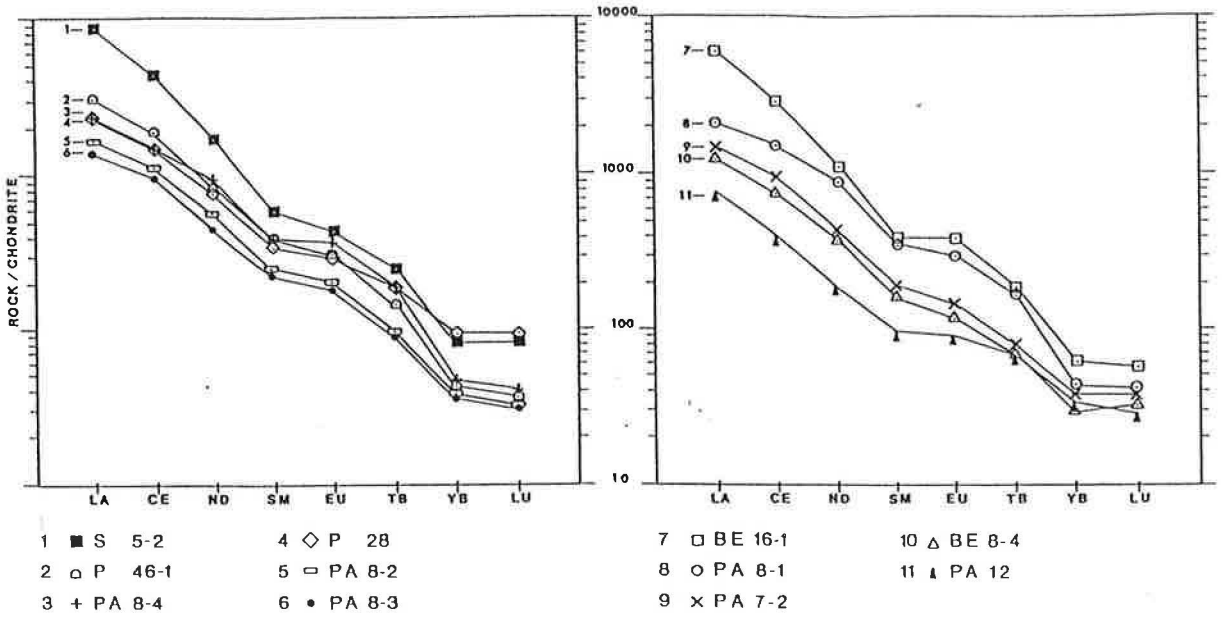

Figure 2 - REE abundance patterns, normalized to chondrites (Masuda et al. 1973) from Fuerteventura carbonatites. Esquinzo complex: headwaters of Enamorados (10) and Agua Salada (7) ravines. Puerto de la Peña-Cueva de Lobos complex: Punta de Nao (9), between Punta de Nao and Caleta Mansa (2, 3, 5, 6 and 8), La Cruz (4) and Gaspar Gonzalez (11) Caletas, and Punta de Peñon Blanco (1).

STABLE ISOTOPE.- 25 isotopic analysis have been made, and the O and C isotope ratios of the carbonatites of the Figure 2 samples range from δ= 6,6 to 11 and -4,8 to -6.5, respectively, and fall within the range of "mantle fields" for carbonatites as defined in Deines (1989). Hoernle and Tilton (1991) propose that the Sr, Nd and Pb isotope ratios from the C.B. rocks are similar, suggesting a close genetic relationship between these. Thus, these authors show that the basal complex magmas originated from a HIMU-like plume but assimilated enriched lithospheric mantle (EM) as they ascended through the lithosphere. This interpretation implies a plume origin for the Fuerteventure carbonatites. The rocks that constitute these alkaline-carbonatite complexes could have been generated by fractionated crystallization and/or liquid inmiscibility proccesses of magmas originated from mantle plumes and the residual liquids was enriched in REE.

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