A LA-ICP-MS STUDY OF CARBONATITES FROM FUERTEVENTURA, CANARY ISLAND

CARNEVALE G. (1), CORREALE A. (2) , PAONITA A. (2) , ROTOLO S. G. (1,2) , ARROYO REY X. (3)

(1) Dipartimento Scienze della Terra e del Mare, Università degli Studi di Palermo
(2) INGV, sezione di Palermo
(3) CAI Técnicas Geológicas, Universidad Complutense de Madrid

Carbonatite complexes are very rare in oceanic settings and in the Atlantic Ocean occur only at São Vicente and São Nicolau (Cape Verde Archipelago) and Fuerteventura (Canary Archipelago).
Fuerteventura consists essentially of Mesozoic sediments, submarine volcanic rocks, subaerial basaltic to trachytic series; intrusives are represented by ultramafic, mafic to felsic rocks and carbonatitic dike swarms (age 25 Ma). Carbonatite dikes mineralogy consists of *calcite*, *aegirine-augite*, *albite*, *K-feldspar*, *biotite*, *apatite*, *Fe-Ti oxides* and accessory minerals, such as *zircon*, *monazite* and *pyrochlore*.
Whole rock XRF analysis are high in CaO (> 50 wt. %) and SrO (> 2-3 wt. %) and very low in MgO (< 1-2 wt. %). Trace elements were determined by LA-ICP-MS on calcite and accessory minerals.

I LOCATION AND SAMPLING

Fig.1: Fuerteventura in its geographic contest.

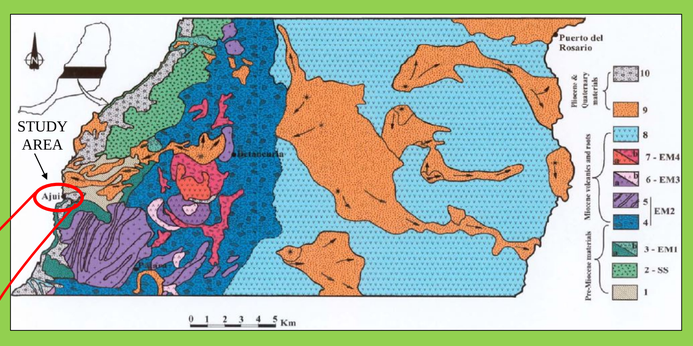

Fig.2: Geological map of the central sector of island with the study area. 1=Mesozoic sediments; 2=submarine series; 3a=subvolcanic-plutonic rocks; 3b=extrusive materials; 4=transitional volcanics; 5=mafic and ultramafic plutonics; 6=V.R.P complex; 6a=gabbros; 6b=syenites; 7=Betancuria edifice; 7a=basalts; 7b=syenites and trachytes; 8=shield volcanics; 9=Pliocene and Quaternary volcanics; 10=Quaternary sediments (Muñoz M. et al, 2003).

Fig. 3: Filled aspects of the study carbonatite complex (A). Carbonatite dyke within pyroxenites host (B).

II PETROGRAPHY

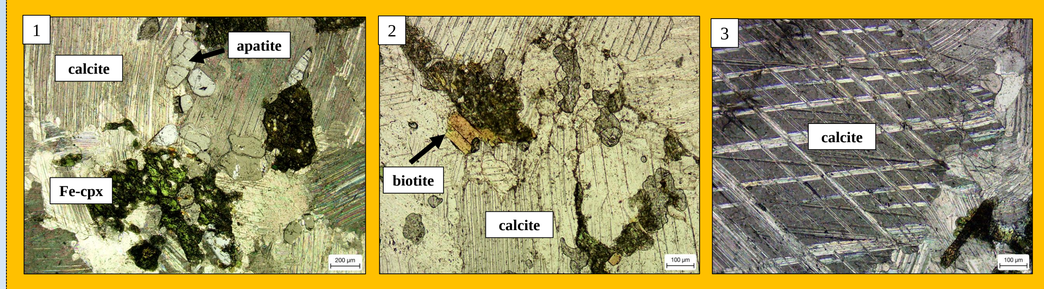

Fig. 4: Typical carbonatite mineral assemblage (1 – 2) and detail on different grain size of calcite (3).

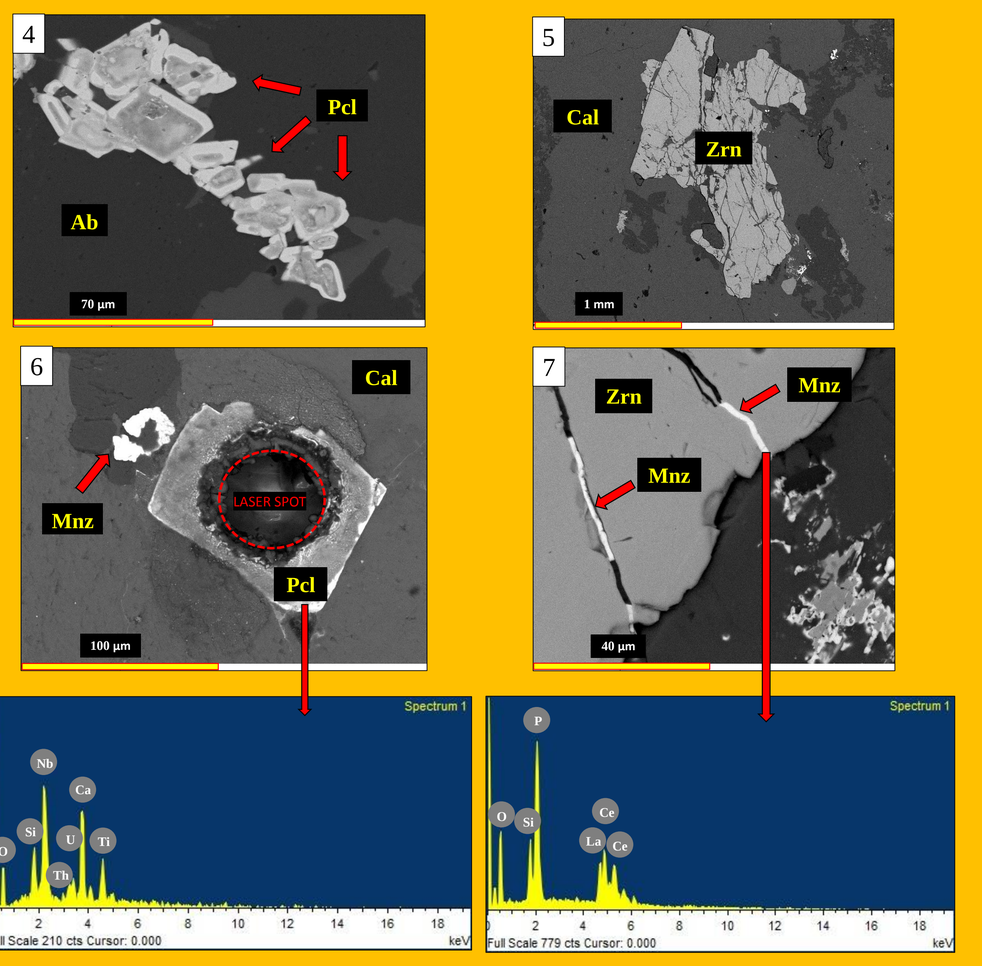

Fig. 5: SEM-BSE images of some accessory minerals. Albite and pyrochlore (4); zircon phenocryst (5); monazite and pyrochlore (6) and monazite-filled microfractures enriched in LREE (7). Ab = albite; Cal = calcite; Mnz = monazite; Pcl = pyrochlore; Zrn = zircon.

III X-RAY DIFFRACTION

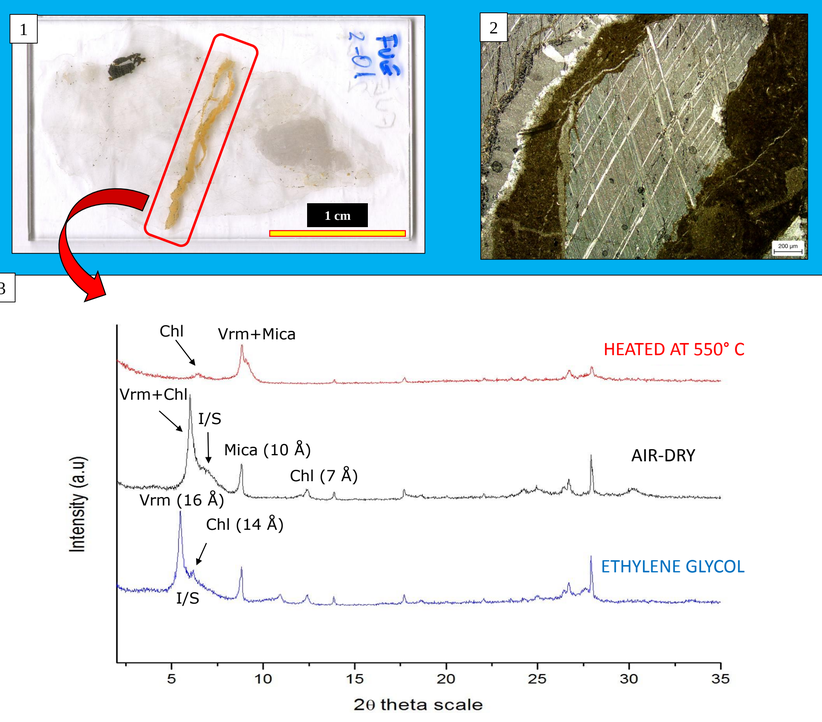

Fig. 6: Secondary veins in carbonatite (1-2), XRD patterns on decarbonated < 0.5 µm fraction of vein-filling material under different treatments (3). Chl = chlorite; I = illite; S = smectite (montmorillonite); Vrm = vermiculite.

IV GEOCHEMISTRY (LA-ICP-MS)

Major constituents

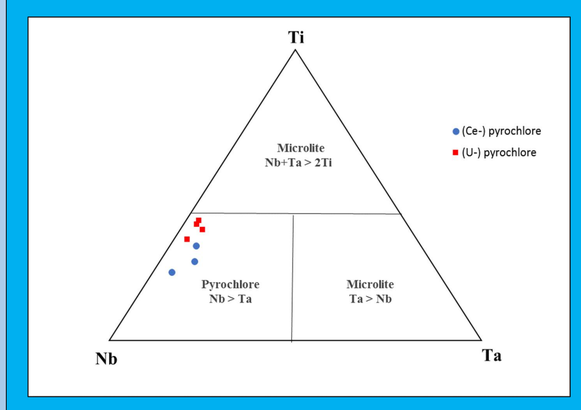

Fig. 7: Compositional diagram for pyrochlore (LA-ICP-MS).

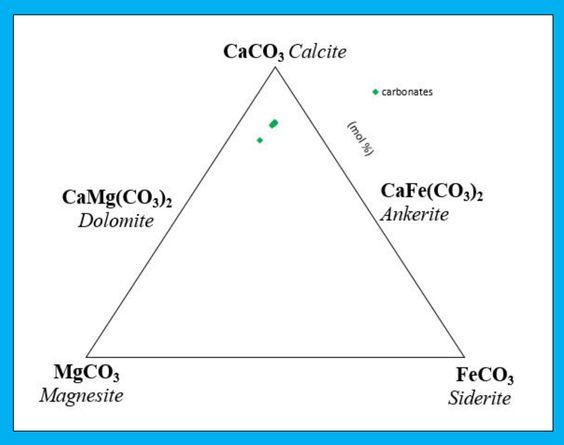

Fig. 8: Compositional diagram for carbonates (SEM-EDS mol % of end members).

Trace elements and REE

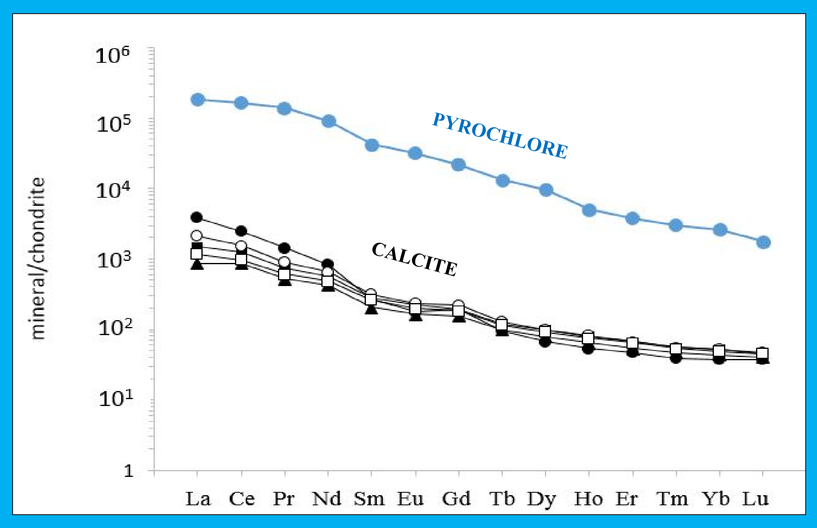

Fig. 9: REE patterns in pyrochlore and calcite minerals.

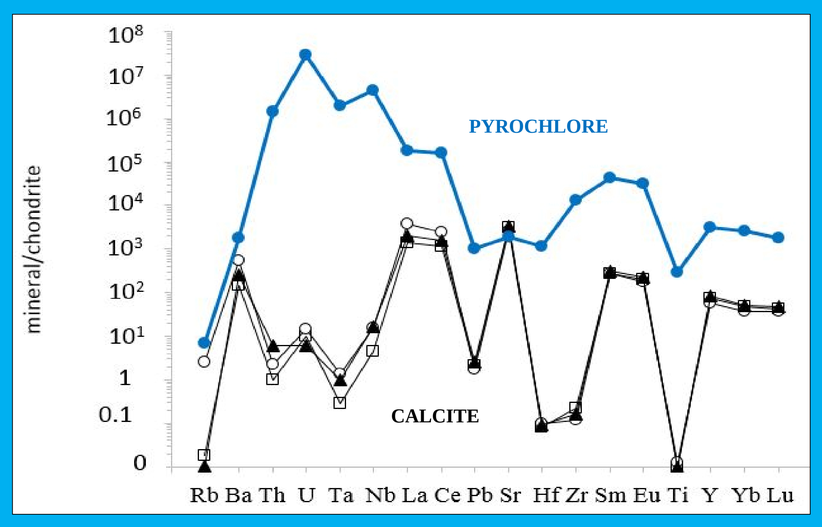

Fig. 10: Spider diagram for trace elements and REE in pyrochlore and calcite minerals.

RESULTS AND CONCLUSIONS

- The degree of alteration of carbonatites (evaluated by DTA and XRD) is generally low, with the occurrence of illite-montmorillonite mixed layers, vermiculite and chlorite.
- Results show in calcite phenocrysts REE patterns highly enriched in all REEs (sum REE = 1478 - 2601 ppm) and particularly in LREE: La_N = 2662 (chondrite normalized), Ce_N = 1972, with respect to HREE (Yb_N = 46, Lu_N = 42) and rather fractionated pattern $(La/Yb)_N$ = 57. Small to moderate negative Eu anomalies do also occur (Eu/Eu* = 0.94 - 0.77) and these are coupled with high Sr positive anomalies (Sr/Sr* = 27.2 - 56.1).
- REE in pyrochlore are extremely enriched in REE (sum REE = 21.7 wt %) with very high LREE (La_N = 185817 and Ce_N = 165210) and HREE (Yb_N = 2589, Lu_N = 1814) with a slightly steeper pattern if compared to calcite: $(La/Yb)_N$ = 72. No significative Eu anomalies were found (Eu/Eu* = 1.06), while there is a consistent strontium positive spike in spider diagram (Sr/Sr* = 2.25).
- Preliminar results show that pyrochlore is the main mineral repository of REEs and its occurrence, even in trace amounts, gives the trace element fingerprint to whole rock.

REFERENCES

Ahijado A., Casillas R., Nagy G., Fernàndez C. (2005) *Sr-rich minerals in a carbonatite skarn, Fuerteventura, Canary Islands (Spain).* Mineralogy and Petrology, 84 (107-127)
Mangas J., Pérez Torrado F. J., Reguilón R. M., Martín-Izard A. (1997) *Rare earth minerals in carbonatites of Basal Complex of Fuerteventura (Canary Islands, Spain).* Mineral Deposits (475-478)
Muñoz M., De Ignacio C., Sagredo J. (2003) *What controls the location and timing of transfer of mantle carbon through the crust? Fuerteventura Guide.* IV Eurocarb Workshop, Canary Islands, Spain (1-77)