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CONCENTRACION DE TIERRAS RARAS EN ALGUNAS ROCAS VOLCANICAS DE UN PERFIL DE LA CORDILLERA CENTRAL, COLOMBIA: CUENCA DEL CAUCA, NEVADO EL RUIZ, FORMACION CASABIANCA

REE CONCENTRATIONS IN SOME VOLCANIC ROCKS FROM A CROSS-SECTION THROUGH THE CENTRAL CORDILLERA, COLOMBIA: CAUCA BASIN, NEVADO EL RUIZ,CASABIANCA FORMATION

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This contribution forms part of a series of detailed studies on the Ruiz - Tolima Volcanic Zone of the Central Cordillera (Colombia) initiated by an International Cooperation (Convenio INGEOMINAS, Colombia - University of Grenoble, France).

Herein, we discuss the REE chemistry of some samples characterized by one of us (R.S., Medellín) for their mineralogy.

Sc, Cs, Hf, REE, Ta and Th were determined by instrumental neutron activation analysis (INAA) at Grenoble (France), for 10 samples representative of the range of 4 stratigraphic units:

A) **The Diabase Group:** Upper Cretaceous submarine fine-grained dolerites interbedded with detrital sediments; *83-260:* carretera Marsella, West. Cordillera, 1360 m (4° 57' N - 75° 43' W); *83-252:* Campo Alegre, Esmeralda, West. Cordillera, 1000 m, dolerites with vesicles filled with zeolites (5° 04' 30" N - 75° 42' 30" W).

B) **The Cauca Basin and the Casabianca Formation:** Mio-Pliocene volcaniclastic deposits exposed in the Cauca Basin, and Late Pliocene to possible Early Pleistocene complex pyroclastic and volcaniclastic deposits exposed in the Magdalena valley (Eastern Piedmont). Lavas are two-pyroxene and amphibole andesites. *83-267:* Rio Consota, Fonda Placer, Cauca Basin, 1150 m, (4° 47' N - 75° 53' W); *83-278A:* Letras volcano-tectonic depression, Fresno, Casabianca Fm., 1550 m.

The Nevado El Ruiz is an andesitic composite and currently active volcano covering some 250 km^2, rising up to 5400 m and located approximatly 175 km East of the Pacific Trench (4° 50'55' N - 75° 15-20' W).

C) **The Basal Section** (1.2 to 0.6 Ma): large differentiated lava flows and pyroclastic deposits; *82-54:* Peña Margarita, carretera Manizales, 3250 m, clinopyroxene basaltic

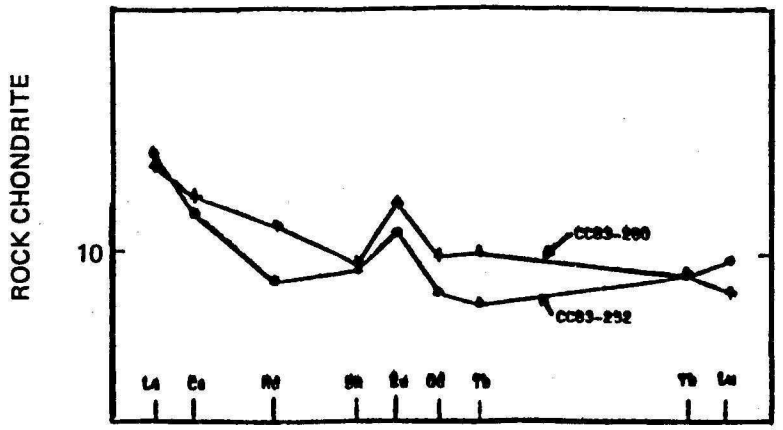

Fig. 1. Padrón tipo T-MORB de tierras raras normalizado en muestras del Grupo Diabásico, Cordillera Occidental.

Fig. 1. T-MORB REE normalized pattern from the Diabase Group, western cordillera.

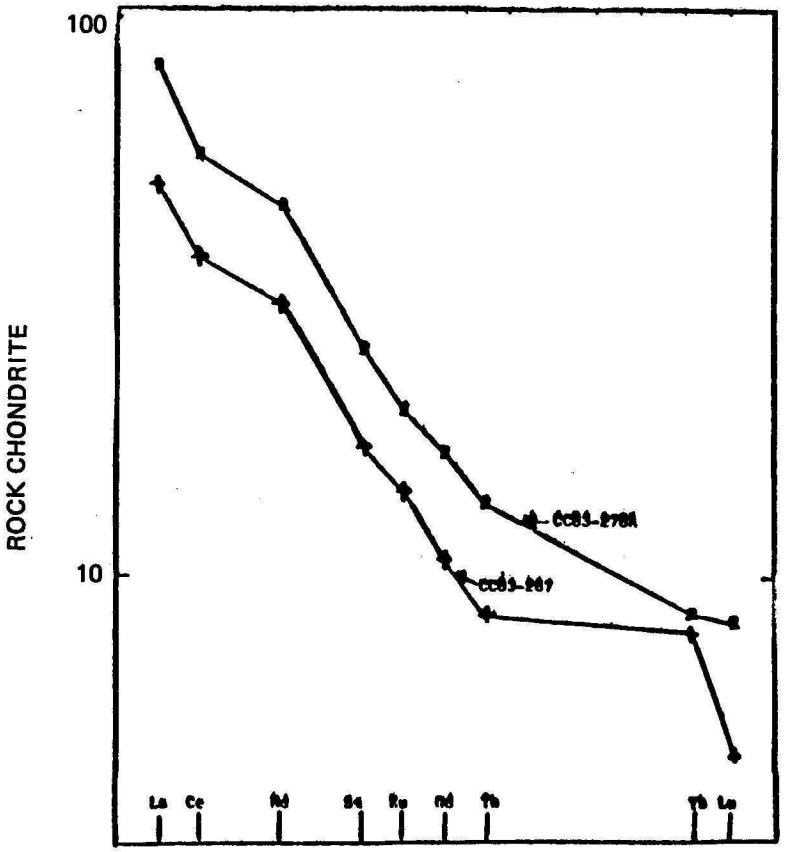

Fig. 2. Padrón normalizado de tierras raras para muestras de Cuenca Cauca y Formación Casabianca.

Fig. 2. REE normalized pattern of sample from Cauca Basin and Casabianca Formation.

andesites; *83-219:* Alto Aguila, Arbolito, 3950 m, two-pyroxene and amphibole acidic andesites; *83-218:* Peña Cachucha, dacitic dome, 3600 m.

D) The Upper Section (up to 0.3 Ma): composite volcano of andesitic flows, dacitic plugs and adventive domes, an explosive vent on the NNE flank collapsed by cataclysmic explosion on March 12, 1595 (debris avalanche deposits, pumice and ash flows) and an active summit crater Arenas. *82-48:* La Pica, Rio Claro, 3300 m, orthopyroxene andesites; *82-58:* La Laguna, 2250 m, phyric two-pyroxene andesitic block-lavas; *82-50:* Alto La Piramide, Holocene ENE flank dome, 4375 m, aphyric clinopyroxene andesites.

Characteristics of the chondrite-normalized REE distribution patterns are shown in Fig.1 to 4 (chondrite da a from Nakamura, 1974).

In Fig. 1, the Diabase Group show a T-type MORB pattern with flat HREE centred around 10. Well developed positive Eu anomalies and systematic LREE enrichments suggest the presence of a plagioclasic cumulative phase or the remelting of cumulates; both may affect significantly the Eu and LREE behaviours.

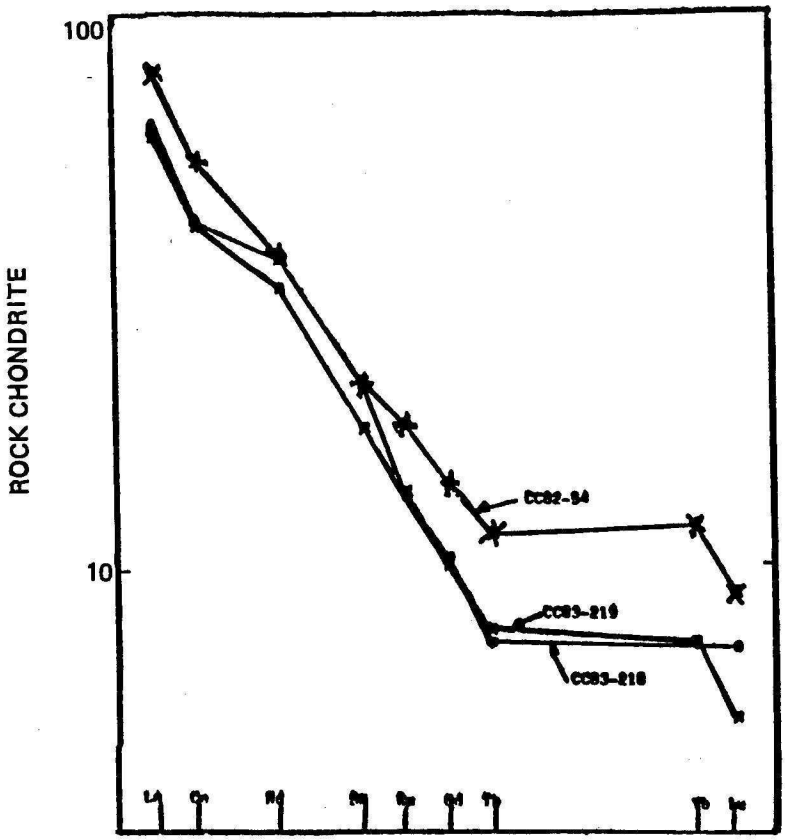

Fig. 3. Padrón normalizado de tierras raras para muestras de la seccion basal de Nevado El Ruiz, Cordillera Central.

Fig. 3. Normalized REE pattern for rocks of the Basal Section of Nevados El Ruiz, Central Cordillera.

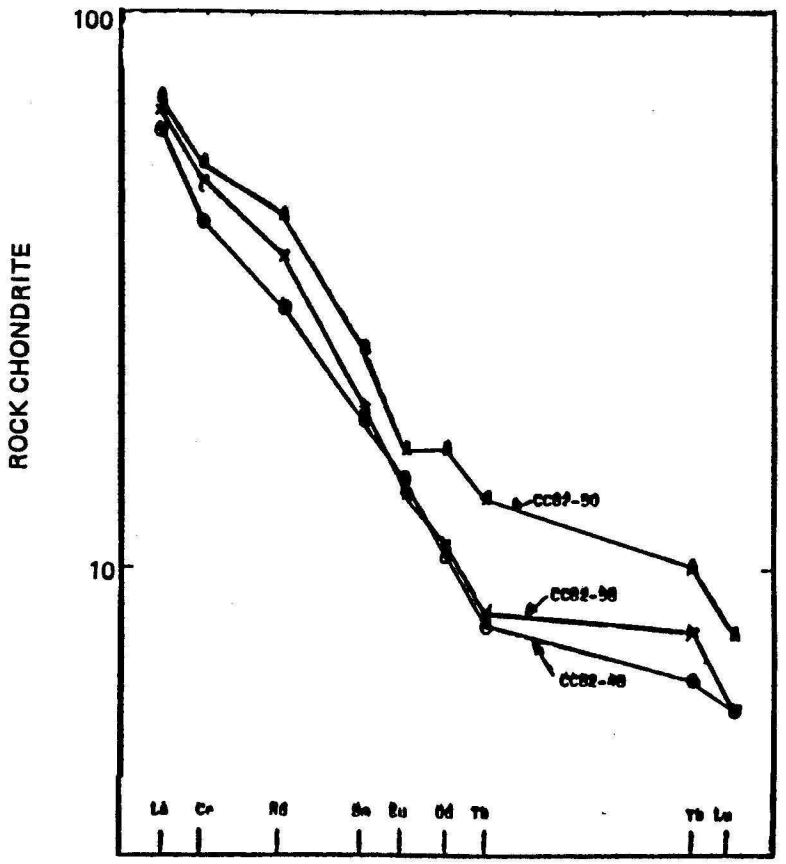

Fig. 4. Padrón normalizado de tierras raras para rocas de la Sección superior del Nevado El Ruiz, Cordillera Central.

Fig. 4. Normalized REE pattern for the Upper Section, Nevado El Ruiz, Central Cordillera.

These dolerites (SiO_2 = 48%) show a very consistent enrichment in Sc (45 ppm) and particularly in Ta (0.7 - 0.9 ppm) and low abundances in Hf (1.2 - 1.4 ppm). These values contrast with those obtained by Marriner and Millward (1984) on other lavas of the Diabase Group.

As shown in Fig. 2, 3 and 4, the overall REE patterns of Ruiz lavas and their pyroclastic basement are similar to those of the calcalkaline suites from subduction zones. The majority of rocks have 59 - 62% SiO_2, 1.8 - 2.4 K_2O and high Ba (680 - 1050 ppm) like other Andean andesites, and display LREE - enriched patterns and non depletion of HREE.

Compared with the Ruiz samples of similar SiO_2, REE distribution patterns of the Mio-Pliocene andesites (Fig. 2) are parallel to those of the Basal Section of the Ruiz, whereas those of the lavas from Letras volcano-depression are identical to the Holocene domes. The difference between the two groups is shown by a more pronounced MREE (middle rare earth elements) depletion, especially in EU (Fig. 4), together with an increased value of Sc (44 ppm) in the Holocene lavas.

In time, the concentrations of Cs, U and Sc increase and Ba, Hf and Ta remain unchanged with uniform low abundances. Th values show a large heterogeneity.