GEOCHEMISTRY OF THE GARZON GRANULITES IN THE COLOMBIAN ANDES: EVIDENCE FOR PROTEROZOIC CALCALKALINE MAGMATISM

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Resumen

El estudio de la distribución de los macro- y microelementos en las granulitas precámbricas del Macizo de Garzón en la Cordillera Oriental de Colombia ha mostrado que los protolitos del Macizo constituyen esencialmente una serie volcánica calcoalcalina formada en un ambiente tectónico similar al actual.

Introduction

The Garzón Massif, the most extensive outcrop of Precambrian basement in the Colombian Andes, forms part of a Mid-Proterozoic orogenic belt of continental dimensions following the trend of the present Andes along the western border of the Amazonian Craton (Litherland et al., 1985). The Garzón Massif consists of charnockitic, enderbitic, mafic and ultramafic granulites with intercalations of pelitic, calcsilicate and alkalisyenitic gneisses (Kroonenberg, 1982a,b). Granulite-facies metamorphism under intermediate pressure conditions took place around 1.2 Ga according to geochronological data, possibly during a collisional orogenic event. During this event (Nickerie Orogeny, cf. Grenvillian) the Garzón belt accreted onto an older 1.6 Ga granitoid basement which crops out locally in the same area and which forms a prolongation of the Amazonian Craton (Priem et al., 1989).

Geochemistry

Major and trace elements have been analysed by XRFS and INAA to establish the tectonic setting of the Garzón granulites. Charnockitic, enderbitic, mafic and ultramafic granulites show a clear calc-alkaline differentiation trend. This is evident from a TAS (Total Alkali-Silica) plot of all metaigneous granulite samples (Fig. 1). Trace elements also corroborate a calc-alkaline affinity. Cr and Ni are strongly enriched in the ultramafics, and decrease with increasing FeO/MgO. Compatible elements such as Sc, V, and Co decrease with increasing differentiation. Mafic granulites plot essentially in the

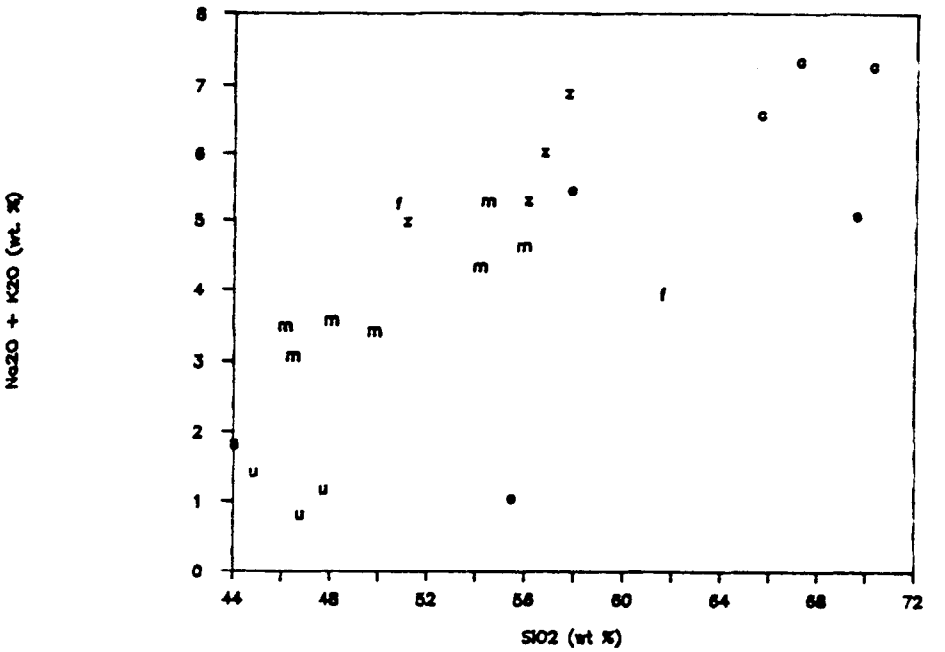

Fig. 1. Total alkali - silica diagram for all metaigneous granulites (pelitic gneisses, calcsilicate rocks and alkalisyenitic gneiss omitted).

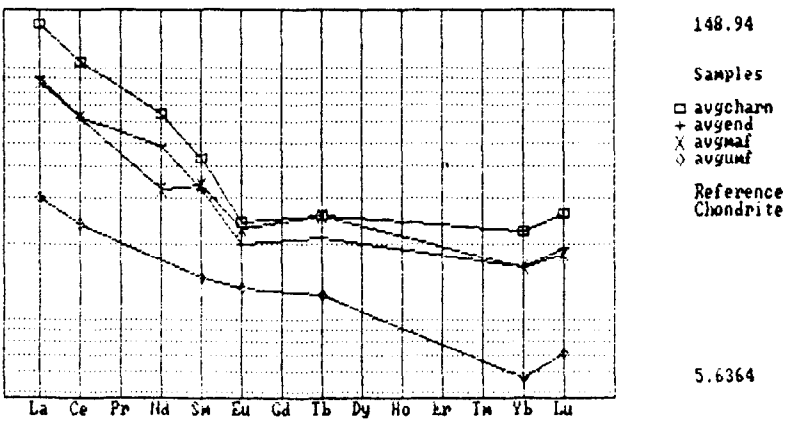

Fig. 2. REE spectra for averages of charnockitic (N=3), enderbitic (N=3), mafic (N=11) and ultramafic (N=4) granulites.

calc-calkaline or low-K tholeiite field in Pearce discriminant function diagrams. REE patterns show enrichment in LREE (average La_N/Yb_N 5.8) with smooth profiles in the mafic granulites and with slight negative Eu-anomalies in the more felsic ones (Fig. 2). ΣREE decreases from 205 ppm in felsic granulites to 120 ppm in the mafics and averages 36 ppm in the ultramafic granulites. These data are compatible with a magma origin from an already LREE enriched source. Two mafic granulites with petrographic evidence for the reaction opx+plag -> cpx+gar+qz show unusually high FeO/MgO ratios, flat REE patterns with positive Eu anomalies and anomalous LIL enrichment, notably Ba, Zr and Hf.

Conclusion

Most data for the felsic, intermediate, mafic and ultramafic granulites are consistent with an origin from a sequence of igneous rocks of a calc-alkaline differentiation series. The banded character and the intercalations of metapelitic and calcsilicate rocks suggest a supracrustal origin. The Proterozoic tectonic setting was therefore similar to the present subduction-related environment of the Colombian Andes. Apparently there have been at least three periods of widespread calc-alkaline volcanism in the history of the Colombian Andes: a Proterozoic one, a Triassic-Jurassic one, and the present one.

Acknowledgements

Analyses were carried out at the Service Laboratory of Utrecht Institute for Earth Sciences, the INAA analyses at the Interuniversity Reactor Institute at Delft, both by courtesy of Dr. H. de Boorder. For plotting results use has been made of the GCDP package developed by F.J. Peeters and J.T.J. Jorna, by courtesy of Drs. F.F. Beunk, Free University, Amsterdam.

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