SBGf13399

Gamma spectrometric studies on the Cretacic Island Arc Complex in Central-East Cuba

Rigoberto L. Prieto Cainzos*
Elisabete M. Pascholati
Gilberto Amaral

*FAPESP/ IG-UNICAMP/ IGP(Cuba) IG – UNICAMP , IG – UNICAMP

ABSTRACT

K and Th gamma spectrometric maps demonstrate to be a good tool for geological mapping of the Cretaceous Magmatic Island Arc of Central-East Cuba. High Th values are generally associated with sodium rich calcic-alkaline plutonic and volcanic rocks. Small anomalies over carbonatic rocks seem to be associated with laterization processes. High K values are normally associated with calcic-alkaline and alkaline rocks of the Magmatic Arc. The possibility of potassium metasomatism associated with mineralization processes is under examination near known deposits.

INTRODUCTION

During the last decades, gamma spectrometry studies are becoming one of the most important tools for geologic mapping and mineral exploration. Measurement of K, U and Th concentrations of surface materials are indicative of subsurface lithology. Hydrothermal and metasomatic alteration associated with mineralization processes can also be identified.

This paper aims to define the significance of gamma spectrometry characteristics for a better definition of the Cretaceous Magmatic Arc of Cuba. K, U and Th concentrations were obtained during the Levantamiento Aerogeofisico Complejo (LAGC), carried out between 1979 and 1985. This project was flown at an average height of 60m along N-S lines with 500m spacing. Sampling interval was 50m. The resulting data was interpolated by kriging for a grid with 250m spacing (Prieto et al. 1997).

The selected area for this study is located in Central-East Cuba, between 77^o – 79^o 30'W and 20^o 30'- 22^o N (Figure 1).

Geologically the study area is formed by NW-SE trending belts, which reflect the regional geological evolution pattern as discussed by Iturralde-Vinent (1994). From NE towards SE, those belts represent: the Bahamas platform, the ophiolitic complex and the magmatic arc (Figure 2). The Bahamas platform represent the mainly carbonatic sedimentary cover (Middle Jurassic – Upper Cretaceous) of the southern portion of the North American Platform. The ophiolitic complex was formed by the exposition of Mesozoic oceanic crust after the collision of the Protocaribean plate with the North American Platform. The magmatic arc developed as a volcano-plutonic island arc near the border of the Protocaribean plate. The result of the collision was the development of the North Caribean Fold Belt (Middle Campanian – Middle Eocene), an extremely complex mixing of lithologies formed under different tectonic environments. The general tectonic polarity is towards NE in direction of the North American Platform. Superimposed basins, filled with thick detritic and carbonatic sediments, close the orogeny. From Upper Eocene to Quaternary, post-orogenic subsidence originates depressions filled with marine and lacustrine sediments (Neoauthocton).

The plutonic portion of the magmatic arc (Lower Cretaceous - Middle Campanian) can be divided into three compositional groups: normal calcic-alkaline; sodic calcic-alkaline and alkaline (Eguipko et al. 1984). The first is composed by tonalitic to granodioritic rocks: quartz monzonites, monzodiorites, gabbro-diorites, tonalites, granodiorites, quartz monzonites and biotite-hornblende granites. The sodic calcic-alkaline group is low in K (average 0.4%) which is replaced by Na. The alkaline group rocks have a higher K content (average 3.8%), being formed by sub-alkaline gabbros (K ~2.2%), biotite-hornblende syenites and quartz syenites. Contact metamorphism is common: amphibolitization, chloritization, silicification, zeolitization and propilitization being the most common types. Several types of mineral deposits are associated with these alteration zones.

The volcano-sedimentary part is composed by three sequences: back arc (sedimentary and reworked pyroclastic); axial (volcanics, tuffs and sediments) and fore arc (sediments and pyroclastics), approximately distributed from north to south, parallel to the oceanic trench to the south. Tholeiitic lavas are more frequent in the basal portions, calcic-alkaline at the middle and alkaline at the top.

The ophiolitic complex is represented by a complete association, ranging from gabbro-peridotites to oceanic basalts and radiolarites. The age varies from Jurassic – Early Cretaceous to Campanian.

Structurally NW-SE inverse and thrust faults dominate. Large NE-SW transcurrent faults (by ex. La Trocha) cut the entire region and are associated with drags indicating dominant sinistral movement.

RESULTS AND DISCUSSION

The regional eTh (ppm) distribution is presented in Figure 3. Anomalous areas (> 6 ppm) can be seen at the northwest portion and in other points of the area. These anomalies are mainly developed over carbonatic Cenozoic sediments. One possible explanation would be the common Th association with laterization processes as already reported in other areas in Cuba, Brazil and Australia (Galbraith et al. 1983). However, these areas are also high in U (not shown in this paper), but low in K . As a consequence, the presence of low K plutonics under a thin sedimentary cover would be the most probable explanation. This is an important point to be developed since lateritic bauxite is common over limestones of the region (Jamaica, etc.) . Figure 4 presents the K map (%). The central portion is occupied by a NW-SE belt of larger values (> 1.8%). These values are associated with normal calcic-alkaline and alkaline volcanic and plutonic assemblages. This map shows a clear tendency for a K increase from NW towards SE, probably reflecting a corresponding increase in the duration of differentiation processes. Large NW-SE lineaments are clearly seen in this map and seem to be related to a fault contact between dominantly volcanic and dominantly plutonic assemblages of the magmatic arc.

CONCLUSIONS

Th and K are the most important radioelements for the characterization and mapping of the magmatic complexes of the Volcanic Arc. Some anomalies are clearly associated with mapped lithologies, which could be extrapolated for less known areas. Identification of lateritic alteration based on Th anomalies were indicated, but must be verified by fieldwork and analysis of previous detailed geological work. Potassium metasomatism associated with mineralization processes is a real possibility and will be looked for near known occurrences.

REFERENCES

Eguipko, O.1984, Principales particularidades petroquímicas de los granitoides del eugeo-sinclinal cubano y sus formaciones. (Ed.) Ciencias de la Tierra y del Espacio, La Habana, , 9, 59-73.

Galbraith, J.H. and Saunders, D.F. 1983, Rocks Classification by Characteristics of Aerial Gamma-ray Measurement. Journal of Geochemical Exploration, 18, 49 - 73.

Iturralde-Vinent, M.A. 1994, Introduction to Cuban Geology and Geophisycs. In: Iturralde-Vinent, M.A (Ed). Cuban Ophiolites and Volcanic Arc. IGCP Project 364: Geological Correlation of Ophiolites and Volcanic Terranes in the Circum Caribbean, 3 – 35.

Prieto, R.L., Pascholati, E.M, Amaral and G. 1997, Processamento Digital de Dados Aerogeofísicos (Magnetometria e Gamaspectrometria) da Folha Bayamo, SW de Cuba. In: 5th International, Congress of the Brazilian Geophisical Society, São Paulo, 1997. Anais.. São Paulo, SBGF, 1, 588-590.

ACKNOWLEDGMENTS

Thanks are due to FAPESP for the financial support (Proc. 94/3700-0) and to the Instituto de Geologia y Paleontologia of Cuba for geophysical data base.

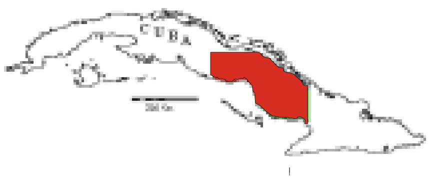

Figure 1 - Location Map for Central-East Cuba.

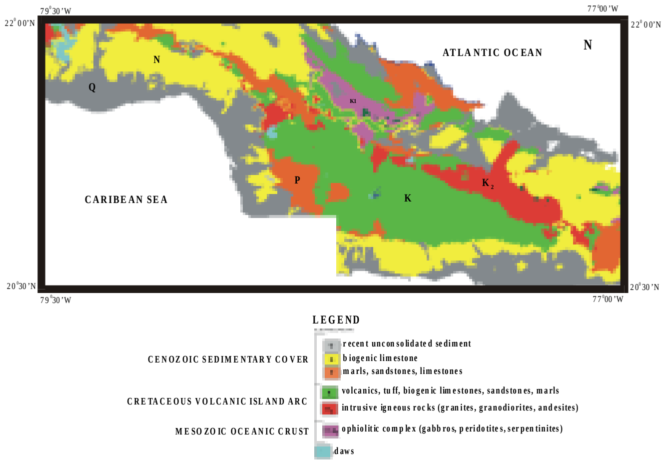

Figure 2 – Geological Map for Central – East Cuba (modified from Linares et al. 1988)

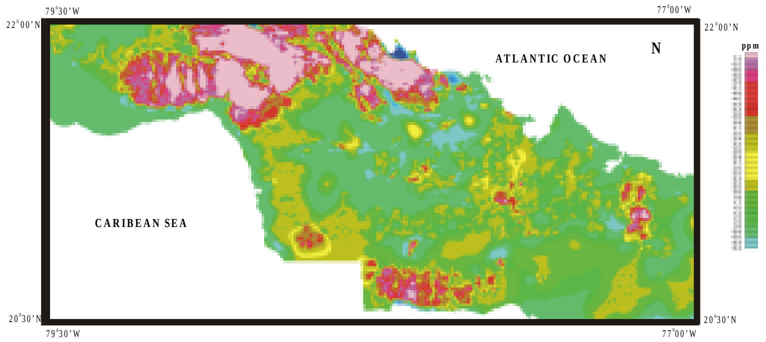

Figure 3 – Regional distribution map of eTh (ppm) for Central – East Cuba

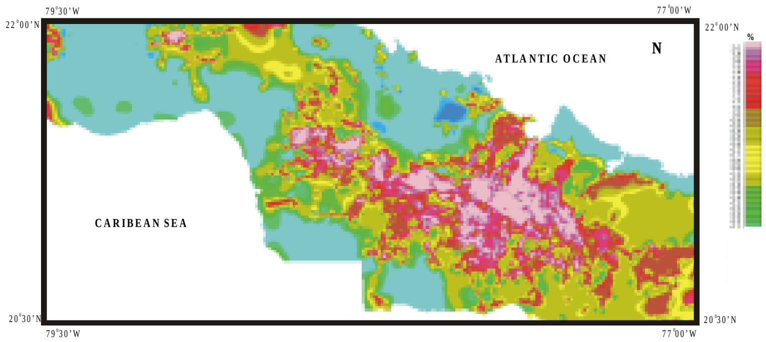

Figure 4 – Regional distribution map of K (%) for Central – East Cuba