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Magnetic features on the Cretacic Island Arc Complex in Central-East Cuba

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ABSTRACT

The structural framework of Central-East Cuba is clearly displayed in magnetic anomaly maps. A strongly positive NW-SE trending zone, at the central portion of the area, seems to correspond to crustal thinning and/or large volumes of basic rocks. Intermediate intensity areas are associated with sedimentary or sedimentary and felsic volcanic sequences, respectively of the Bahamas platform and Magmatic Arc. Low intensity areas correspond to deeper sedimentary basins and ophiolitic complexes. Despite its high magnetic susceptibilities, these sequences are probably tectonically overturned with reversal of the magnetization vectors.

INTRODUCTION

The Cretaceous Volcanic Island Arch of Central – East Cuba is the most prominent feature of the region. Besides its academic importance, it is associated to several important mineral deposits of different origins. It was mapped in the 1:50,000 scale but many problems remain, mainly related to its deep structure and its association with rocks that are more superficial and structures. The main objective of this paper is clarifying these problems by the use of aeromagnetic data collected during the Levantamiento Geofísico Complejo (Prieto et al. 1997, 1998 a, 1998 b). This project was developed during 1979-1985 and is comprised by N-S flight lines spaced 500m and 60m above ground. Measurements were made at each 50m along flight. These measurements were interpolated by kriging to a square grid spaced 250 m.
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) and correspond to the 1:250,000 sheets of Camagüey, Bayamo and Ciego de Avila.
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. 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, 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

At this stage, processing was restricted to reduction to pole and upward continuation (1500 m). These transformations

enhanced deep and superficial features and its relations with the known lithologic and structural features.
The reduced to the pole residual magnetic field (Baranov et al. 1964) is presented in Figure 3. It varies from –543 to 762 nT and reflects the complexity of the region. Extensive positive areas are probably related to crustal thinning whereas small ones seem to correspond to basic intrusions and volcanics. However, the ophiolitic sequences, with high magnetic susceptibilities, present negative values contrary to expectations. This could be explained by the overturning of remanent magnetization vectors as a result of the collisional deformation. A detailed study of small bipolar anomalies is in progress, in order to evaluate this problem. The anomaly pattern in this map is affected by curving and breaking, reflecting the regional structural organization. Transverse NE-SW faulting is associated with drags indicating sinistral movement.
Figure 4 shows the upward continuation map for 1500m calculated from the reduced to pole residual map. The low pass filtered anomaly is similar and also suggestive for a crustal thinning. This interpretation is being checked with the help of gravimetric data, which also shows positive anomalies. Intermediate intensity (-100 – 100 nT) anomalies at the northern portion of the area seem associated with thick sedimentation along the border of the Bahamas platform. Negative areas (< -100 nT) are associated with thick sedimentation or with the ophiolites.

CONCLUSIONS

As the main result of the interpretation of magnetic data, it is proposed a subdivision of the region into three magnetic units (Figure 5).
Unit A is characterized by high anomalies (from 100 to 600 nT), related to crustal thinning and/or large volumes of basic magmatic rocks. It occupies most of the central portion of the area and is oriented parallel to the collision zone.
Unit B has intermediate values, between – 100 nT and 100 nT and corresponds mostly to thick sedimentary sequences related to the Bahamas platform or to the sedimentary and felsic volcanic assemblages of the magmatic arc.
Unit C has values between –100 and –500 nT and is associated to the deeper sedimentary filling of the late and post-tectonic basins. The ophiolitic sequences are included in this unit probably as a result of the intense deformation and reversal of magnetization vectors.

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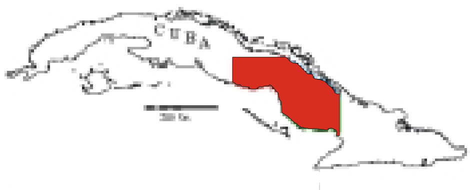


Figure 1 - Location Map for Central-East Cuba.

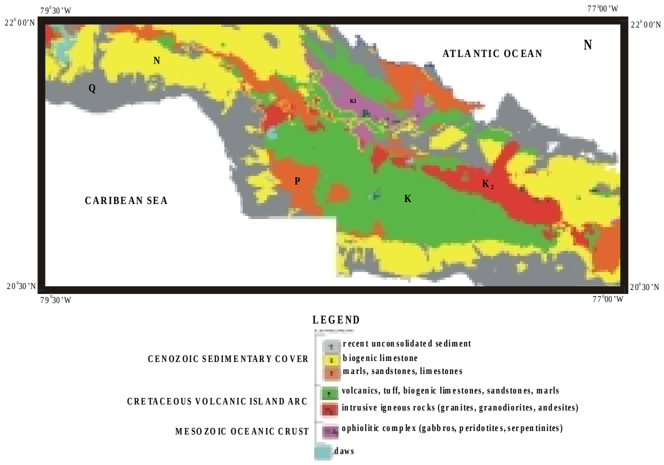


Figure 2 – Geological Map for Central – East Cuba (modified from Linares et al. 1988)

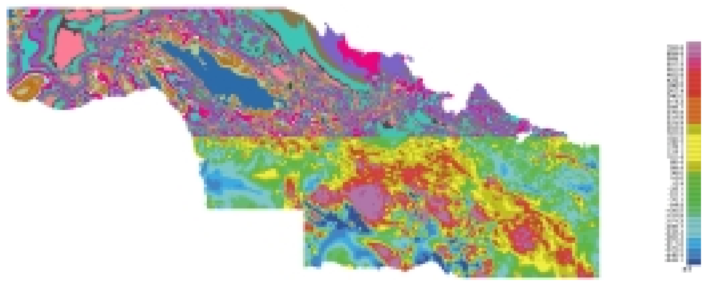


Figura 3 – Reduced to pole magnetic residual map for Central – East Cuba

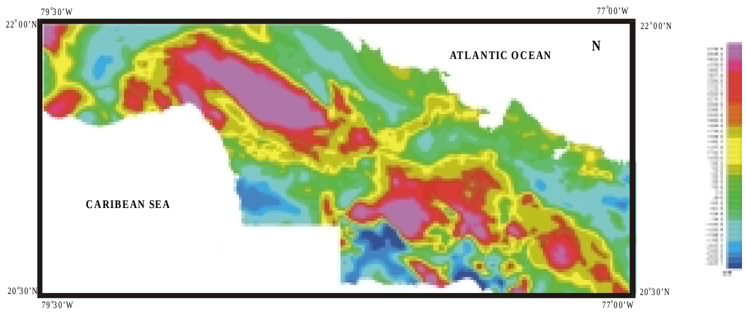
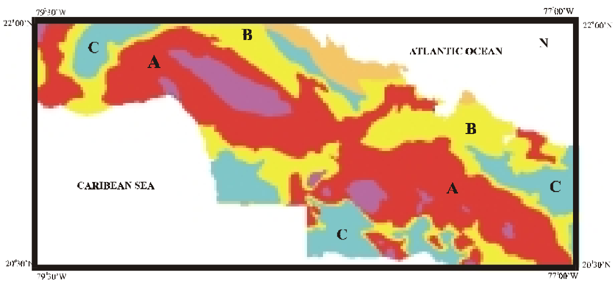


Figure 4 – Reduced to pole magnetic residual map with upward continuation (1500 m) for Central – East Cuba



LEGEND

A, B, C- magnetics unids

Figure 5 – Magnetic unids distribution for Central – East Cuba