GRAVITY and MAGNETIC MODELLING ACROSS THE GUARICO SUB-BASIN, ESPINO GRABEN, VENEZUELA

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INTRODUCTION

This work examines the subsurface structure of the Guarico Sub-basin, across the southwestern extension of the Espino Graben in the central part of Venezuela (Fig. N° 1), through an analysis of gravity and magnetic anomalies.

CENTRAL VENEZUELA TECTONIC SETTING:

The Guarico Sub-basin is an east-northeastern trending and east plunging structural depression located in the central part of Venezuela (Fig. N° 2). It is approximately 200 km long and 120 km wide, and it is bounded on the South by the Guayana Shield, on the North by the Coastal Cordillera –Cordillera de La Costa- with the Villa de Cura complex and nappes up to the Guarico Frontal Thrust; on the west by El Baul Swell (an alkaline granite, 287±10 m.y. (Rb/Sr), 270±10 m.y. (K/Ar), Santamaria and Schubert, 1974; González de Juana et al., 1980)). On the East the Guarico Sub-basin is limited by the Urica Fault, a possible paleofracture of Precambrian age, reactivated during the collision process as a right-strike-slip fault (Daal et al., 1989; Erikson, 1994), and then continues through the Eastern Venezuelan Foreland Basin. The crystalline basement of the Precambrian Guayana Shield, which crops up southward of the Orinoco River, is made up mostly of metasedimentary and igneous rocks, with granite batholiths of homogeneous composition (Case et al., 1984).

One of the earliest apparent traces of some extensional regime in central Venezuela is the existence of a graben-type structure in the Espino area, where a complete record through the pre-rifting into the rifting stages seems to be present. Feo Codecido et al. (1984) have reported there the presence of 1.6km sequence of red-beds and interbedded basaltic flow (113m thick and 162 m.y. in age) at the northeasterly trending Espino Graben. It seems to indicate that a rifting event might have been felt in that area as early as in Mid to Late Jurassic times. Sedimentation took place from the initial rifting phase, over the Atlantic-type ocean margin developed onto the continental northeastern edge of the South American plate. Towards the end of the Cretaceous and into the Paleocene, the Guayana and the El Baul cratonic areas with their Cretaceous sedimentary cover were uplifted, exposing to erosion the Cretaceous Guarico Sub-basin. While erosion was going on in the South, sedimentation was continuous in the North. At this time Erlich and Barrett (1990) relate the beginning of the first phase of compression-transpression and foreland basin development in Guarico Sub-basin.

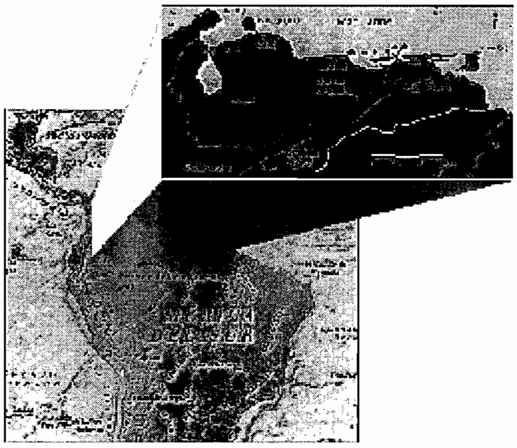

Fig. N° 1 - Location Map of the study area

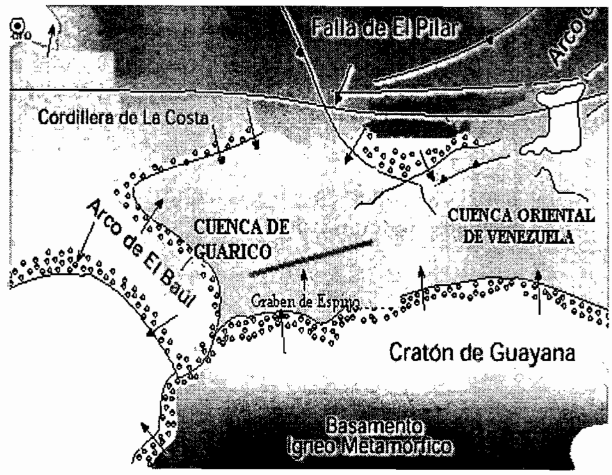

Fig. N° 2 - Geological Setting

GRAVITY and MAGNETIC DATA ANALYSIS

Gravity data from stations between 7°30′N – 8° 30′N of latitude, and 66°45′W-67°45′W of longitude, product of the survey carried out during the course of Field Geophysics 2001, as well as those provided by Cartografia Nacional, Venezuela, were processed to produce the Bouguer Anomaly Map of the area of study (Fig. N° 3). The regional structure is dominated by the East-West to East-Northeast trend of the Guarico Sub-basin and Espino Graben, and is clearly related to the gravity anomaly trend with the same orientation. A positive gravity anomaly belt, which reaches maximum values in excess of 30 mGals occurs over the northern part of the area. Further South the trend is marked by a negative anomaly belt with local minimum more negative than 6 mGals. Along the northern periphery of the basin there is a series of local negative anomalies of the order of 6 mGals.

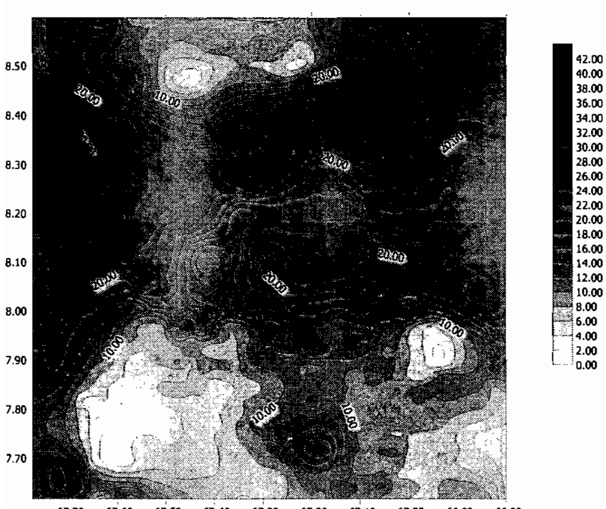

Fig. N° 3.- Bouguer Anomaly Map.

Fig. N° 4.- Total Magnetical Intensity Map.

Magnetic data from the aeromagnetic survey of Venezuela (compiled by Navarro (1989)), were used to produce the Total Magnetical Intensity Map of the area (Fig. N° 4). The magnetic anomalies exhibit a little variable non-symmetrical pattern throughout the region. Nearly East-West trending anomalies dominate the area in clear correlation with the orientation of the basin. Anomalies of the order of 9900 gammas have been identified in the Northern extreme of the area. The most prominent feature in the Magnetic Map is the minimum of 9660 gammas coincident with the Espino Graben.

From the analysis of regional effects in both gravity and magnetic data, a third degree polynomial trend surface was chosen (Figs. N° 4, 5). In those maps the most prominent feature is signed by a negative anomaly (-10 mGals, 9600 gammas) that marks the trace of the Espino Graben.

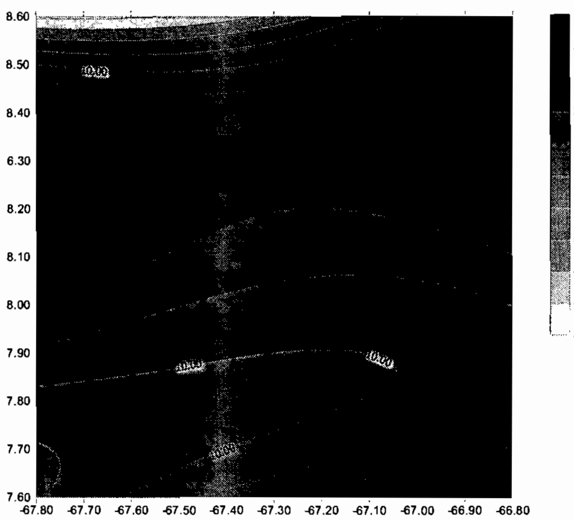

Fig. N° 5.- Regional Bouguer Anomaly Map.

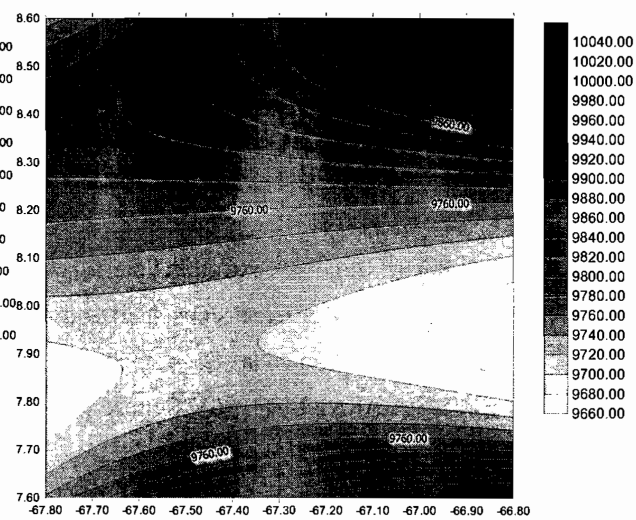

Fig. N° 6.- Regional Total Magnetical Intensity Map.

In order to constrain the models, generalized geological cross-sections based on surface and subsurface data were constructed, and the geological models were converted into a series of polygons with its correspondent densities and magnetic properties to provide the initial input models. Main geological and geophysical constraints imposed to the model come from borehole data (Feo Codecido et al., 1984) seismic and aeromagnetic data (Navarro, 1989). The inclination of the magnetization was assumed parallel to the present field accordingly with the magnetic susceptibility of the rocks in the area, except for the basaltic flows which exhibit significant changes in their magnetic properties.

CONCLUSIONS

A fairly good regional fit is achieved for a model across the Guarico Sub-basin, with a thickness of Tertiary-Cretaceous sediments (ρ = 2.3-2.35 g/cc) of about 1 km, followed by rocks of Paleozoic age (thickness: 5 km, ρ = 2.65 g/cc) overlying a crystalline basement (ρ = 2.75 g/cc). Associated to the Espino Graben there is a sequence of Jurassic rocks (ρ = 2.6 g/cc) with an interbedded basaltic layer (ρ = 2.9 g/cc, thickness 110 km). The modeling also indicates that the whole sedimentary sequence in the basin reaches thicknesses of the order of 6.5km.

REFERENCES

CASE, J.E., T.L HOLCOMBE and R. G. MARTIN (1984) "Map of geologic provinces in the Caribbean region" Scale 1: 5.000.000 In: Bonini, W.E., R.B Hargraves and R. Shagam, Eds. The Caribbean-South American plate boundary and regional tectonics. Geol. Soc. of Amer. Mem. 162: 1-30.

DAAL, A., A. GONZÁLEZ; G HERNÁNDEZ and R. PRIETO (1989) "Exploración de Hidrocarburos en el norte de Monagas ". Internal Report EPHINOM, Comité interfilial CPV-LGV-IM

ERIKSON, J.P. (1994) "A Lower Cretaceous shelf and delta in the Eastern Venezuela Basin". Mem. V Simposio Bolivariano: Exploración Petrolera en las Cuencas Subandinas, Puerto La Cruz, Venezuela. P:174-189

ERLICH, R. N. and S. F BARRETT (1990) "Cenozoic plate tectonic history of the northern Venezuela and Trinidad area". Tectonics 9 (1): 161-184.

FEO CODECIDO, G., F. SMITH, N. ABOUD. and E. Di GIACOMO (1984) "Basement and Paleozoic rocks of the Venezuelan llanos basins". Caribbean- South American plate boundary and regional tectonics. Geol. Soc. of AMER. Mem 162:175-187

GONZÁLEZ DE JUANA, C., J ITURRALDE and X. PICARD (1980) "Geología de Venezuela y sus cuencas petrolíferas". Caracas. Ed. Foninves. Vol I-II. 103p.

NAVARRO, J. (1989) "Mapa de anomalías de intensidad magnética de Venezuela". Corpovén, S.A. Venezuela. Scale: 1:500.000.

SANTAMARIA F and C SCHUBERT (1974) "Geochemistry and geochronology of the southern Caribbean-northern Venezuela plate boundary" Geol. Soc. of Amer. Bull 85(7): 1085-1098.