CONFERENCIA

STRUCTURAL AND STRATIGRAPHIC PROBLEMS IN THE SERRANIA DEL INTERIOR (BARCELONA - ARAGUA DE MATURIN REGION)

by Emile Rod[1]

(Editor's note: The text of the conference will not be presented in the Boletín Informativo as it will appear in a United States publication. The talk was given at the Tenth Annivaersary meeting held in the auditorium of the Cámara de Comercio on 23 September 1958.)

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[1] Venezuelan Atlantic Refining Company

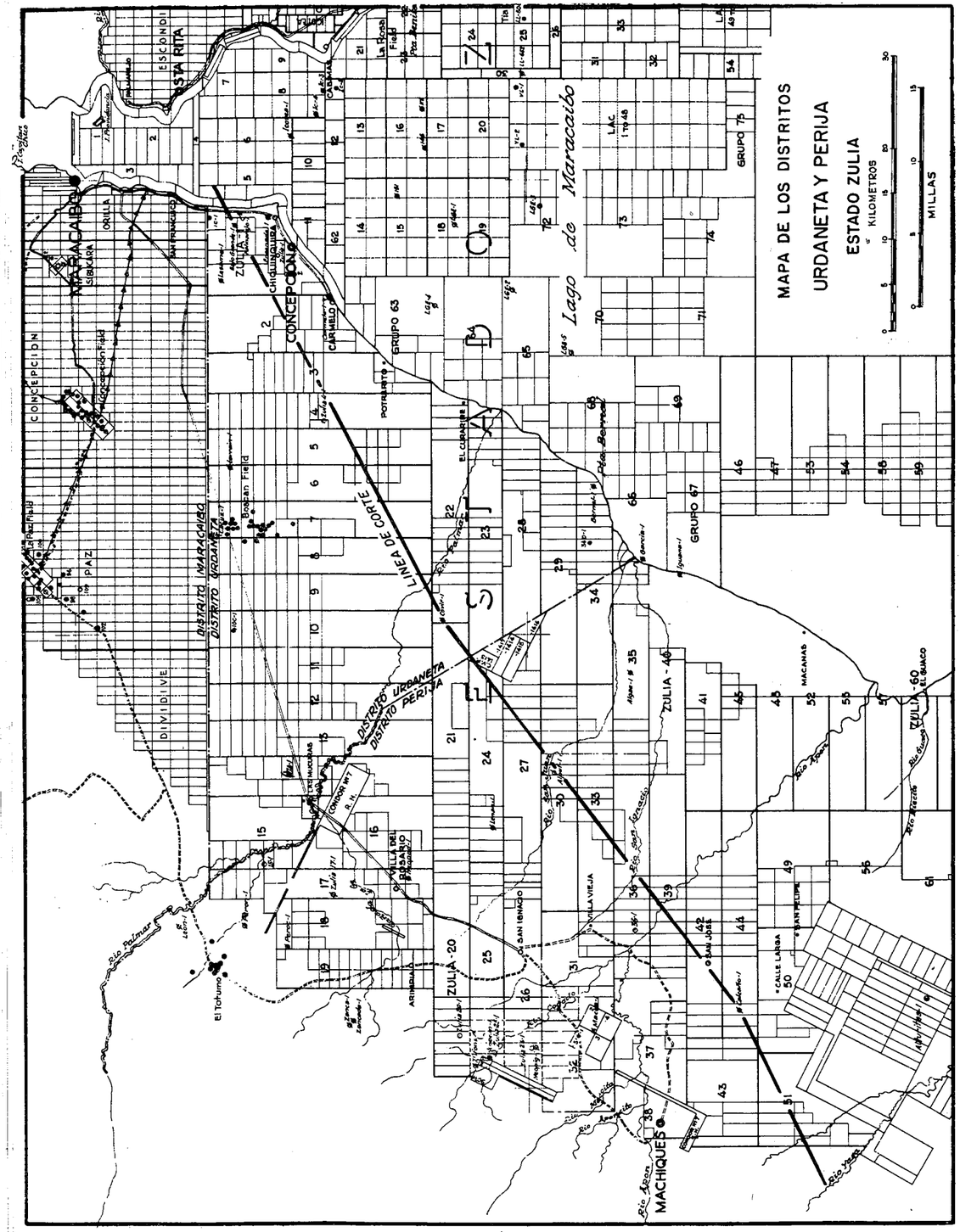

Figure 1. G. Young. Map of the districts of Urdaneta and Perijá. Section-line for Figures 3 to 6 is shown extending from Río Yasa to Chiquinquirá.

ARTICULO

CORRELATION OF THE OLIGO-MIOCENE FORMATIONS IN THE DISTRICTS OF URDANETA AND PERIJÁ, STATE OF ZULIA[1]

by Gordon A. Young[2]

RESUMEN

Las formaciones Oligo-Miocenas de los Distritos Urdaneta y Perijá, al oeste de la Cuenca de Maracaibo, se caracterizan por una interdigitación pronunciada de sedimentos de ambiente terrestre, pantanoso y marino. Como resultado del levantamiento regional al final del Eoceno, depósitos piemontinos, lagunares, lacustrinos y costaneros se extendieron desde las montañas recién formadas hacia el centro de los valles. La transgresión marina del Oligoceno superior, que se extendió por los Estados Falcón y Zulia, llegó hasta el Campo de Boscán, en el Distrito Urdaneta, caracterizando a una serie de sedimentos interdigitados de ambiente salobre y costanero. El Mioceno se caracteriza, en la parte oriental de la región, por la disminución de la influencia marina y al predominio de ambientes salobres y terrestres, con la deposición de gran espesor de arcillas y limolitas.

La información geológica obtenida durante los últimos años ha permitido un concepto más claro, y posiblemente más ajustado a la realidad, acerca de la correlación de estos sedimentos. Los datos provienen del estudio de las muestras obtenidas de numerosos pozos diseminados en la región.

El grupo El Fausto, compuesto esencialmente de sedimentos no marinos, se divide de arriba hacia abajo en las formaciones Cuiba, Macoa y Peroc, las cuales han sido consideradas hasta años recientes como equivalentes occidentales de la formación Icotea de ambiente terrestre. En el informe se exponen los conceptos siguientes: (1) sólo la formación Peroc cambia lateralmente hacia el este en la formación Icotea, con la cual se interdigita; (2) la formación Macoa de ambiente salobre es reemplazada lateralmente hacia el este por la formación La Rosa de ambiente marino; (3) la formación Cuiba de carácter no marino es equivalente a la parte inferior de ambiente salobre a marino de la formación Lagunillas, en el este; (4) las areniscas de origen terrestre de la formación Los Ranchos cambian lateralmente hacia el este en las arcillas de la parte superior de la formación Lagunillas, caracterizada por interestratificaciones de naturaleza salobre y costanera; y (5) las arcillas moteadas de la formación La Villa, de ambiente terrestre a salobre y localmente con influencia más marina, yacen sobre todos los depósitos antes mencionados.

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[1] This paper is presented with the permission of the Mene Grande Oil Co. and the Richmond Exploration Co. A résumé of this paper was presented before the assembly of the A.V.A.C., Sec. Geol., VI Convención, in 1956.

[2] Mene Grande Oil Co.

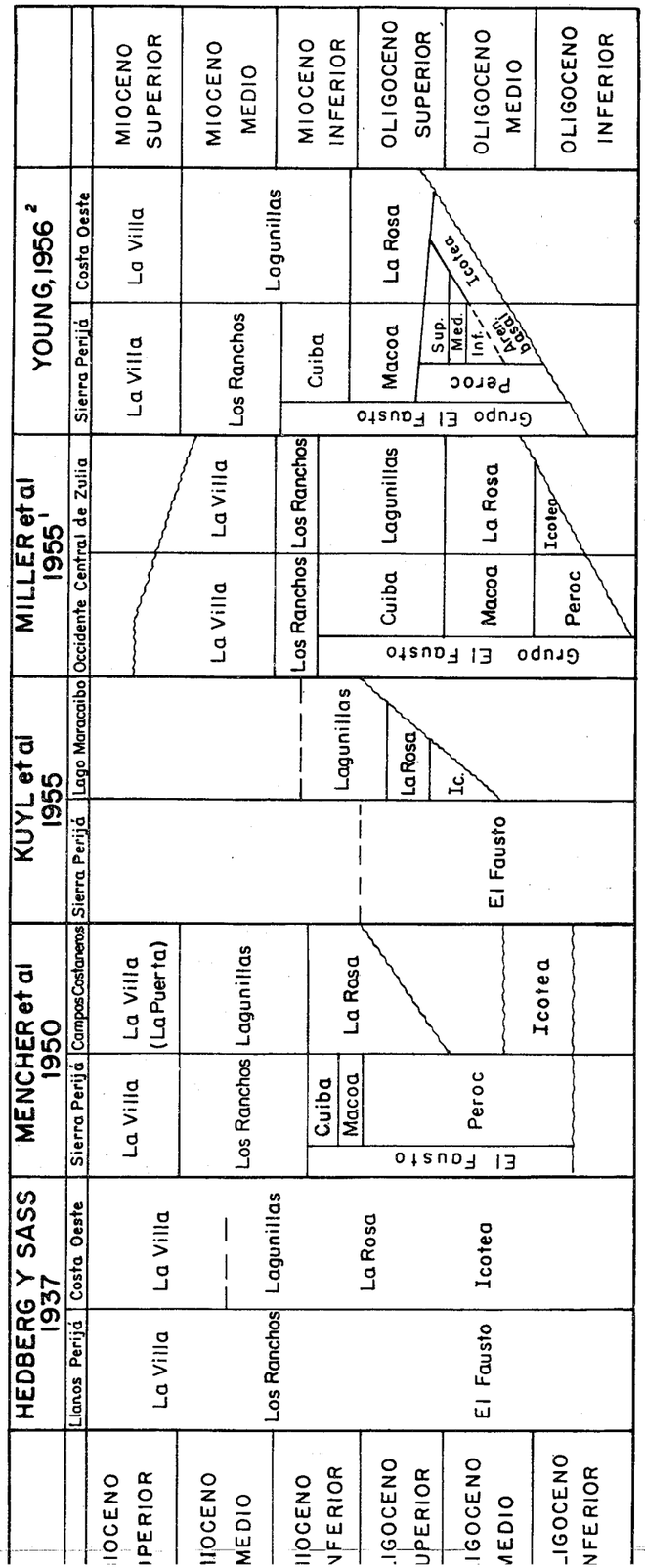

Figure 2. G. Young. Chart showing the correlations proposed by several authors. The paired-columns indicate the relationship between the more marine formations to the east and their brackish-water and terrestrial equivalents to the west.

1 Date first presented, New York meeting, A.A.P.G., March 1955; published 1958.
2 Date first presented, VI Congr., A.V.A.C., Caracas Jan. 1956; published (this issue) 1958.

INTRODUCTION

The region under consideration lies within the Districts of Urdaneta and northern Perijá and is bounded on the north by the District of Maracaibo, on the south by the Río Negro, on the east by Lake Maracaibo and on the west by the Sierra de Perijá (Figure 1). The surface geology shows four geomorphologic areas: (1) the mountain area, containing outcrops of Triassic to Miocene sediments; (2) the Recent alluvial fan and cienega area, which extends along the mountain front; (3) the foothill area, such as the Arimpia - Macoa hills, which are formed by the outcrops of the hard sandstones of the Middle Miocene Los Ranchos and the Upper Miocene La Villa formations; and (4) the sabana and coastal plain area, covered by Recent alluvium and river terraces.

This region is in the western part of the Maracaibo - Falcón Basin and during the early Oligocene also formed part of another structural basin that extended westward from the Bolívar coastal area to the Magdalena basin area of Colombia. As a result of the regional uplift at the end of the Eocene, piedmont fans, lagunal, lacustrine and coastal plain sediments were deposited outward from the recently formed mountains toward the center of the valleys. The marine transgression of the Upper Oligocene spread westward through the States of Falcón and Zulia until it reached Boscán field, so that the Upper Oligocene is characterized by an interfingering of marine, brackish water and coastal plain sediments. The Miocene is characterized, in the eastern part of the area, by a decrease in the marine influence and the predominance of very brackish water and terrestrial environments, with the deposition of a great thickness of clays and silts.

This paper is concerned primarily with the correlation of the Oligocene and Miocene formations and the problems of the relationship between the eastern marine formations and their western brackish-water and terrestrial equivalents. The correlation presented in this paper is a departure from concepts that have been held for the past twenty years, although it has been apparent since 1951 that other geologists in other oil companies have also come to similar conclusions (Figure 2).

Hedberg and Sass (1937, p. 77-120) published the first descriptions of the formations with which we are concerned and placed the El Fausto formation as equivalent to the Icotea on the basis of information from a few scattered wells in central Urdaneta (Table 1). These wells showed an interfingering of El Fausto and Icotea below the La Rosa formation. The La Rosa was considered as a tongue of marine sediments that extended westward from Falcón into the essentially non-marine deposits of Urdaneta and graded laterally into the upper part of the El Fausto formation or the lower part of the Los Ranchos beds (Lagunillas equivalent).

This concept was held for a number of years. Sutton (1946) and González de Juana (1952) published essentially the same relationships but postulated a disconformity between the Los Ranchos and the El Fausto because the La Rosa was missing in the mountain front area. Schaub (1948) followed Sutton in placing a disconformity between the El Fausto and the Los Ranchos, but the hiatus included most of the Lagunillas as well as the La Rosa. He also believed that the deposition of the El Fausto began in the Upper Eocene, which places the lower part as equivalent to the Orumo and Mostrencos formations.

Mencher et al., (1951) were the first to publish the names Cuiba, Macoa and Peroc as divisions of the El Fausto, but did not state whether they were formations or members, and did not publish any descriptions. Geologists of the Richmond Exploration Co., authors of the names, had been using them as formations since 1946. The impor-

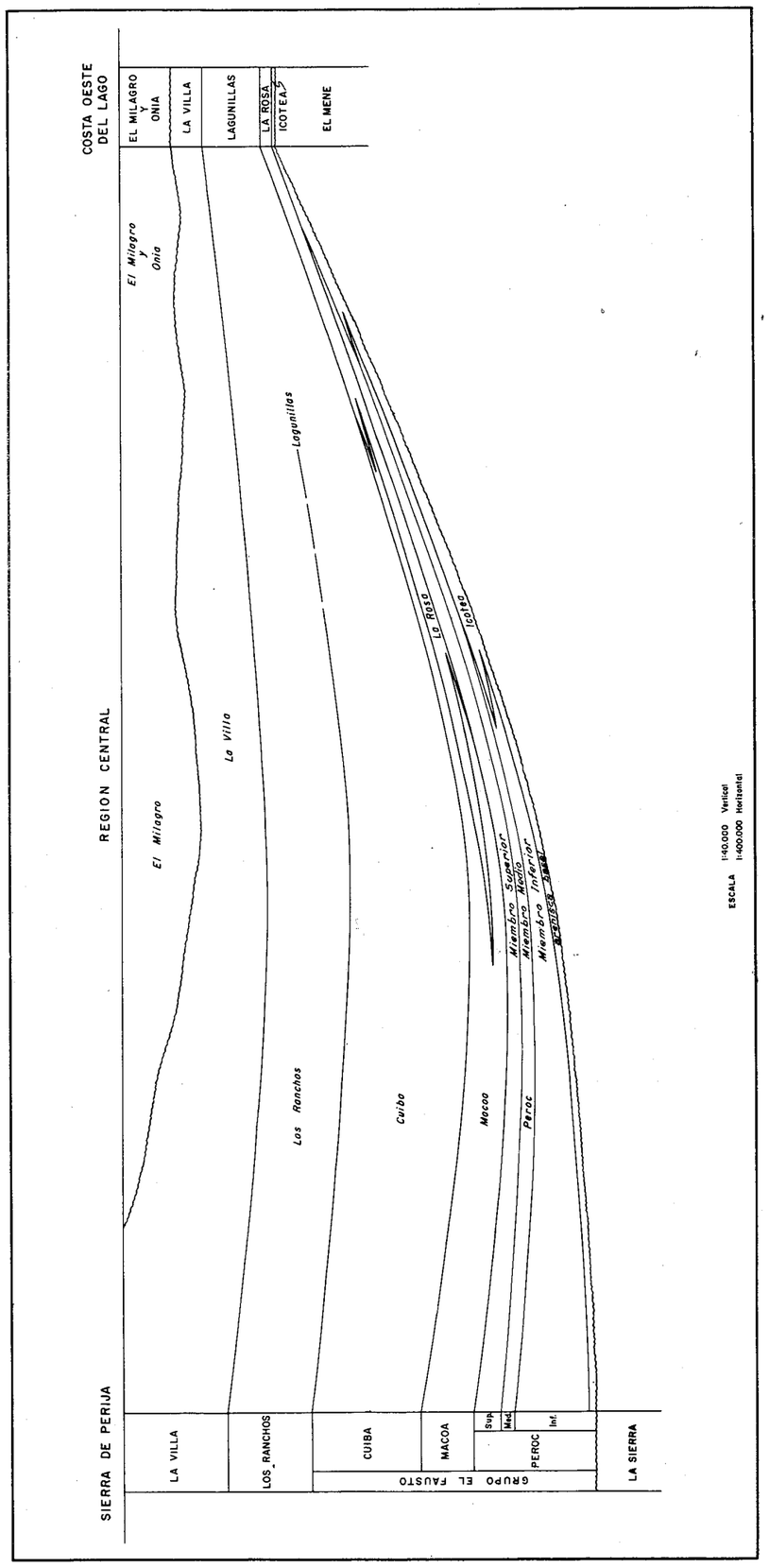

Figure 3. G. Young. Cross-section showing the formational correlation.

tant change in concept was the placing of the La Rosa as equivalent to the upper Peroc, Macoa and Cuiba units rather than assuming a pinchout of the La Rosa or a hiatus. This was due in part to the work done by geologists of the Richmond Exploration Co.

A recent paper on palynological correlation in Western Venezuela by Kuyl, Muller and Waterbolk (1951) also shows the upper El Fausto formation (without divisions) to be equivalent to the Lagunillas, La Rosa and Icotea formations.

Another recent paper by Miller et al. (presented at the AAPG meeting in New York, March 1955; published 1958) indicates that the geologists of the Richmond Exploration Co. had been working along lines similar to those of Gustavo Feo-C. and myself and had reached similar conclusions: that the Peroc is the Icotea equivalent and the Macoa is the La Rosa equivalent. The conclusions differ in that Miller et al. consider that the Cuiba formation is equivalent to the Lagunillas formation and that the Los Ranchos formation overlies both. As the paper was concerned with the habitat of oil, descriptions of the formations or reasons for the correlation were not given.

In the Léxico Estratigráfico de Venezuela (1956), J.B. Miller gave the first complete descriptions, and the type sections, of the Cuiba, Macoa and Peroc formations. The correlation mentioned in the text is the same as that proposed by Miller et al. (1955; 1958).

During 1950-1951, the writer became interested in the problem and set about to analyze the lithologic facies and the related paleontologic facies. Gustavo Feo-C. also became interested and applied a new method for the systematization of heavy mineral suites (conceived by H.D. Hedberg and used by Mene Grande Oil Co. in Eastern Venezuela). The results of this study suggested the following concepts: (1) the basal sandstone of the Peroc formation is the stratigraphic equivalent of the Icotea formation and the three members of the Peroc interfinger and pinch out progressively into the Icotea; (2) the brackish-water Macoa formation grades laterally into and interfingers with the marine La Rosa formation; (3) the non-marine Cuiba formation is equivalent to the brackish-water to marine sediments of the lower part of the Lagunillas formation; (4) the terrestrial sandstones of the Los Ranchos formation change laterally eastward into the coastal plain to brackish-water clays and sands of the upper part of the Lagunillas formation; and (5) the mottled claystones and sands of the La Villa formation, which was deposited under terrestrial, brackish-water, and locally, marine conditions, cover all of the aforementioned deposits.

The problem of the ages of these formations is not discussed in this paper as the ages are very controversial, due to the lack of paleontologic control in non-marine or brackish-water sediments. Most of the ages are based upon the stratigraphic relationship of the formations to the La Rosa formation, which has been variously stated to be Lower Miocene by megafossil determination (Hoffmeister, 1938, p. 118) to Upper Oligocene by pollen determination (Kuyl, 1955, p. 61) to Middle Oligocene (Miller et al, 1955, 1958). In this paper, the La Rosa has been rather arbitrarily placed in the Upper Oligocene, by considering the Aquitanian as Upper Oligocene and following the work of H.H. Renz (1957).

This paper is presented to the Asociación Venezolana de Geología, Minería y Petróleo with the permission of the Richmond Exploration Co. and the Mene Grande Oil Co. and approval of H.J. Funkhouser, Chief Geologist. The writer is exceedingly grateful for the tedious and painstaking work of G. Feo-C. on the heavy mineral determinations, which provided many of the clues to the correlation, and without which the work would have faltered. Much of the information came from reports written by

Table 1. - List of wells drilled between 1924 and 1932 in the Districts of Urdaneta and Perijá, State of Zulia.

Well	Date	Final Depth	Company
Calcaño-1	1930	5738'	Calif. Petrol. Co. - Union Nat. Oil
Neopig-1	1926	3970'	Calif. Petrol. Co. - Union Nat. Oil
Neopod-1	1929	7504'	Calif. Petrol. Co. - Union Nat. Oil
García-1	1928	7102'	Creole Petroleum Corp.
León-1	1929	1619'	Creole Petroleum Corp.
Macoa-1	1930	6638'	Creole Petroleum Corp.
Peroc-1	1930	5600'	Creole Petroleum Corp.
Perón-1	1929	3233'	Creole Petroleum Corp.
Nadir-1	1928	4518'	Lago Petroleum Corp.
Palmarejo-1	1927	3236'	Omium Oil Development Co.
Larrain-1	1929	6850'	Richmond Petroleum Co.
Cacuz-1	1930	6273'	Soc. Française de Rech. au Vénézuéla
Cahuz-1	1929	6438'	Union Nat. Petroleum Co.
Algae-1	1926	2505'	Venezuelan Gulf Oil Co.
Alpuf-1	1926	2284'	Venezuelan Gulf Oil Co.
Bajo Grande-1	1930	5339'	Venezuelan Gulf Oil Co.
Bernal-1	1929	5431'	Venezuelan Gulf Oil Co.
Carmelo-1	1928	5461'	Venezuelan Gulf Oil Co.
Covir-1	1930	8323'	Venezuelan Gulf Oil Co.
Ensenada-1	1929	3996'	Venezuelan Gulf Oil Co.
Lenan-1	1926	2423'	Venezuelan Gulf Oil Co.
Marin-1	1924	2677'	Venezuelan Gulf Oil Co.
Neopam-1	1932	6412'	Venezuelan Gulf Oil Co.

geologists of the Mene Grande Oil Co. during the past 30 years and, while it would be impossible to mention them all, credit should be given to the following: M.N. Bramlette, C.W. Flagler, H.D. Hedberg, L.A. Luecke, and J.T. Scopes. The writer would also like to acknowledge the excellent work of translation into Spanish by G. Feo-C. and J.L. Padrón.

STRATIGRAPHY

The following descriptions of the formations show the characterizing features of each, how the formations may be distinguished from each other, and the reasons for arriving at the correlation presented in this article. These characteristics are also shown graphically by means of three cross-sections through the area: a lithologic correlation (Figure 4), a zonal correlation based on heavy minerals (Figure 5), and a biostratigraphic correlation (Figure 6). Complete descriptions of each lithic type present in a formation are not given here; the reader is referred to the original descriptions (shown in parentheses after the first mention of the name) and the excellent articles by Hedberg and Sass (1937), Sutton (1946), González de Juana (1952) and Miller (1956) for detailed information.

The information used for this article was obtained primarily from a number of old wells (Table 1) drilled between 1924 and 1932. The recently drilled wells have complete information on older formations, but have less core information on post-Eocene sediments.

The La Villa Formation

La Villa formation (Garner, 1926, p. 683), overlain unconformably by the Onia and El Milagro formations, occurs over the entire area outcropping along the mountain front. The greatest thickness is about 3600 feet (which is the thickness in Neopod-1) near the type section, defined by Liddle (1946, p. 508) as extending from La Villa del Rosario to Arimpia, but the total or maximum thickness is unknown due to the post-Miocene erosion.

The La Villa is distinguished from the overlying Onia formation by the change in color from brown and gray clays to predominantly mottled red and gray claystones and the increase of the induration of the clays. The La Villa is also easily distinguished from the El Milagro where that formation overlies it. The formation consists basically of red and gray claystones, but there are many lateral facies changes. From north to south along the mountain front, it changes from a formation consisting of gray sandstones with interbedded mottled red and gray claystone to the typical mottled red and gray with buff claystone (and minor brown and gray siltstone) of the type locality at Rosario. South of Neopam-1, it is absent through erosion until it appears again south of Macoa. Here it apparently occurs as a sand and gravel facies but changes rapidly southward to a facies consisting of brown, red and gray mottled claystone and siltstones and changes again further south (Río Apón) to the more typical red and gray but with a high percentage of lignite.

The characterizing mineral suite of the La Villa is the Simple Suite of the five basic minerals (ilmenite, zircon, rutile, tourmaline, leucoxene) with accompa-

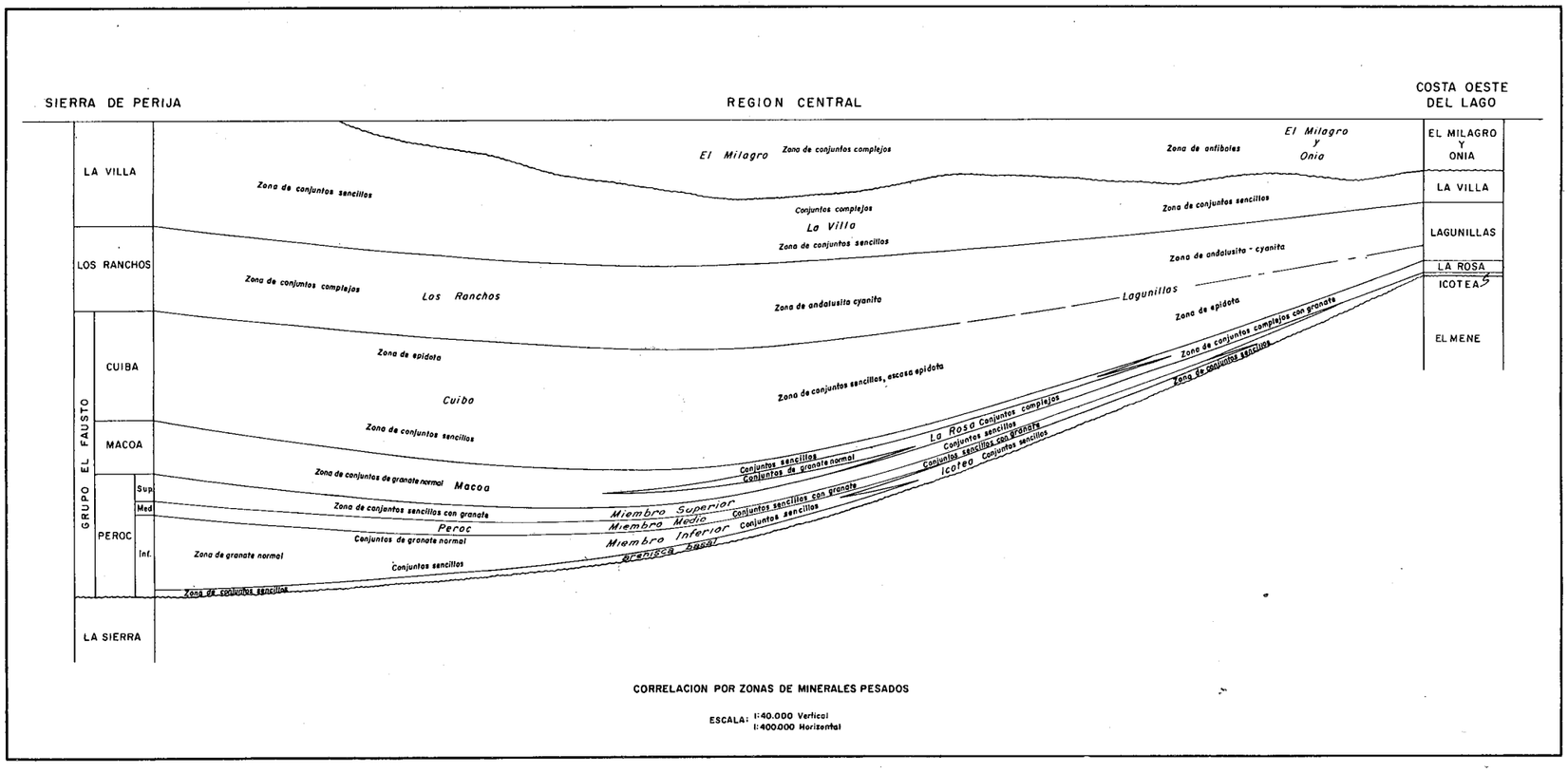

Figure 4. G. Young. Correlation by heavy-mineral zones.

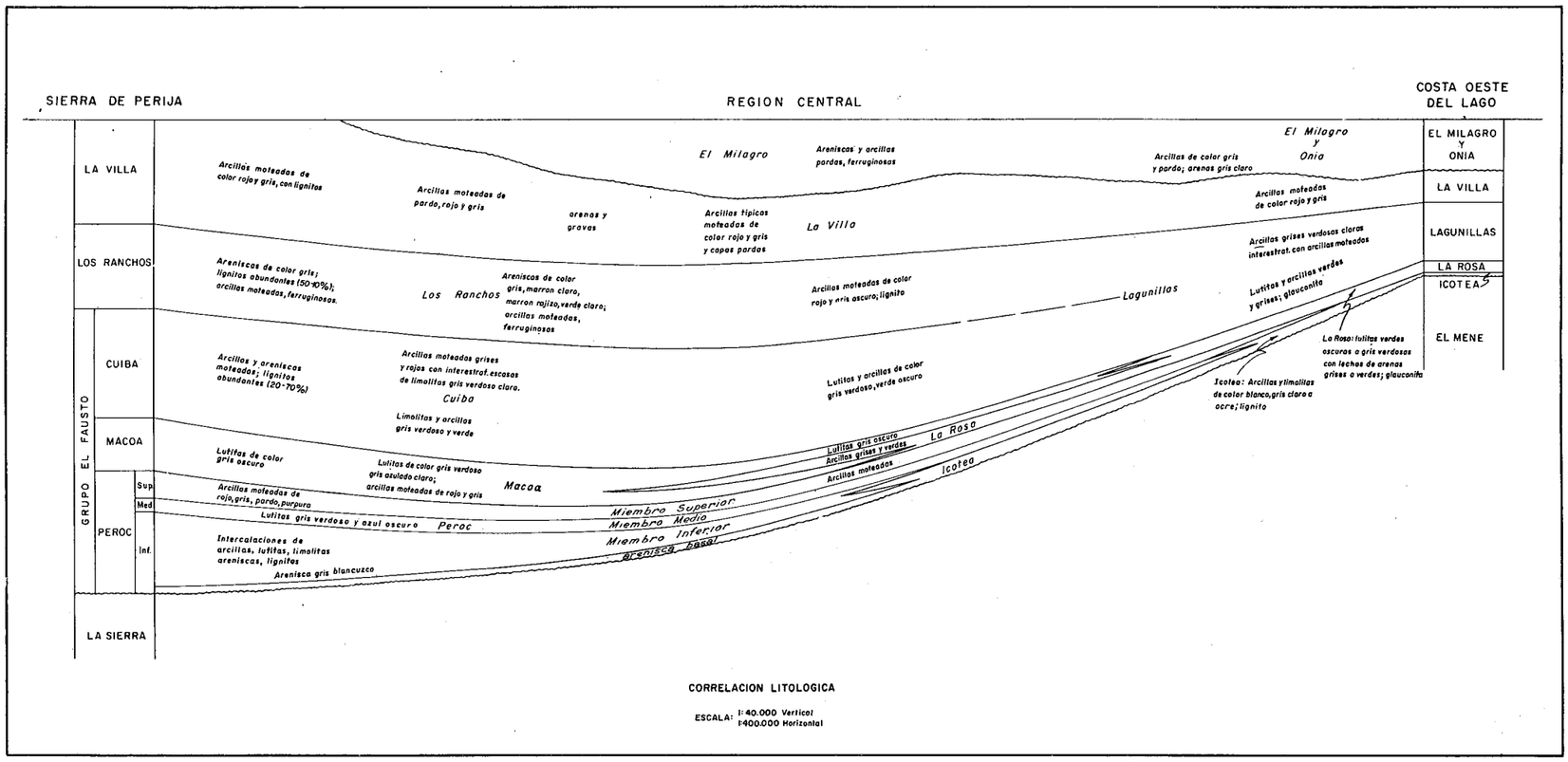

Figure 5. G. Young. Correlation showing the lateral changes in the lithology.

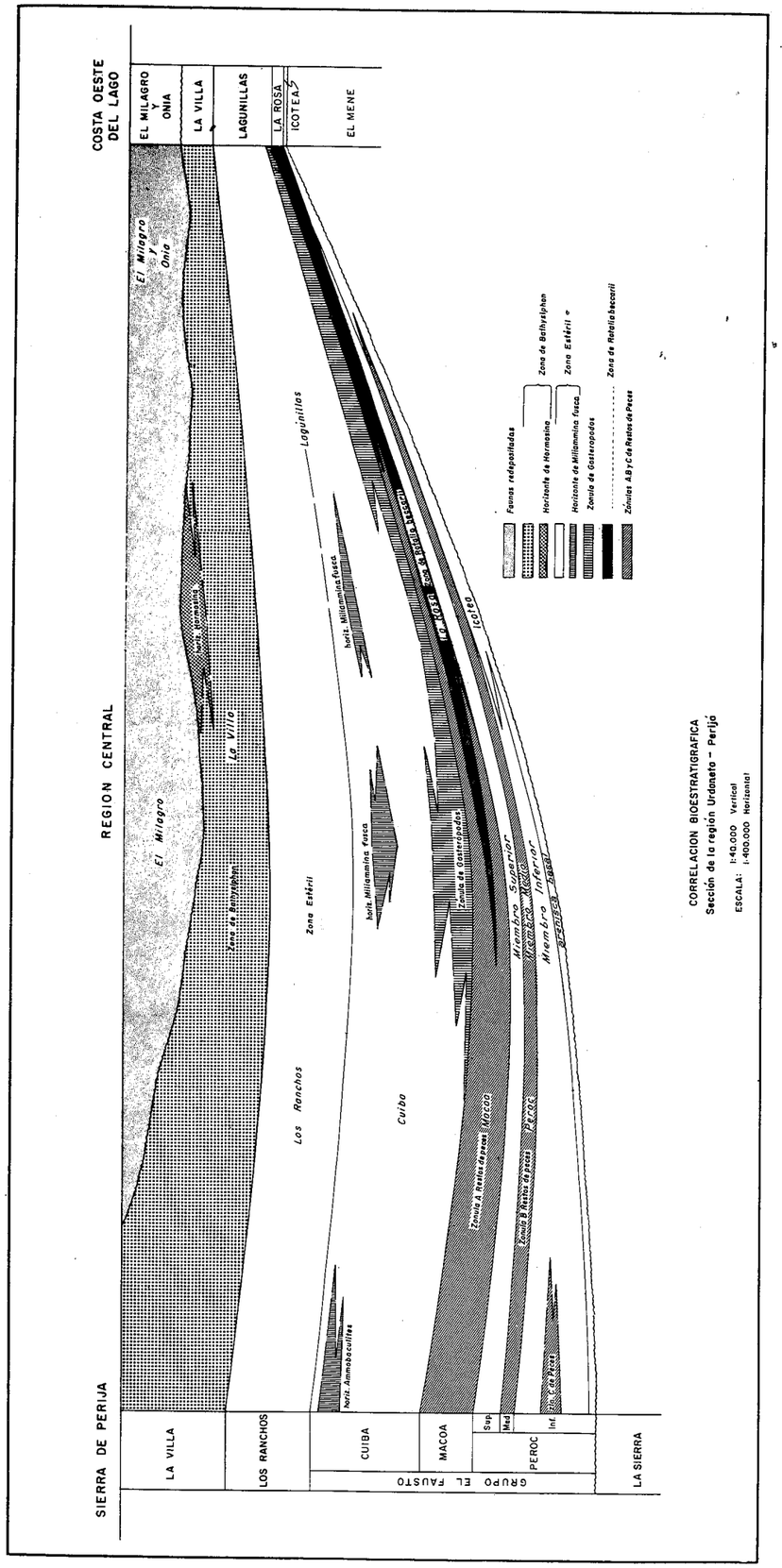

Figure 6. G. Young. Correlation showing the biostratigraphic zones.

nying accessory minerals such as kyanite, andalusite, garnet, staurolite, and epidote.[1] Other commonly occurring suites, locally more common than the simple suite, are the suites with the presence of kyanite and andalusite. Other less common suites are the epidote suite and the more complex suites including the other accessory minerals, such as garnet, chloritoid and staurolite. There do not appear to be any significant stratigraphic mineral changes, although regionally, the southern lake-shore wells contain more complex suites than those to the north (Figure 5).

The paleontology of the La Villa formation consists mostly of reworked foraminifera from the older formations and a few indigenous foraminifera (Bathysiphon, Trochammina, Haplophragmoides, and Cyclammina). In closely spaced wells, local horizons of arenaceous foraminifera are useful for making correlations, for example, the Hormosina horizon in central Urdaneta. Although most of the section is barren, the entire section is called the Bathysiphon zone (Figure 6).

The Los Ranchos Formation

The Los Ranchos formation (Hedberg and Sass, 1937, p. 110), occurs throughout the western part of the area and, near the Boscán field, grades laterally into the upper part of the Lagunillas formation. The formation has a more or less consistent thickness of 1800 feet along the mountain front, thinning eastward to about 1300 feet as it grades into the Lagunillas.

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[1] Based on the work of Gustavo Feo-C. (1956), the following mineral suites are used in this paper:

Simple Suite: consists of the five basic minerals, ilmenite, zircon, rutile, tourmaline and leucoxene.

Simple Suite plus other accessory minerals; such as garnet, staurolite, epidote, chloritoid. Example: Simple Suite plus garnet.

Andalusite-Kyanite Suite: contains the Simple Suite plus andalusite, kyanite and staurolite.

Epidote Suite: the Simple Suite plus epidote and clinozoisite.

Normal Garnet Suite: the Simple Suite plus normal garnet and chloritoid.

Complex Suite: the Simple Suite plus epidote, clinozoisite, kyanite, andalusite, staurolite, and sometimes normal garnet or chloritoid.

Amphibole Suite: the Complex Suite plus amphiboles.

Lithologically, the Los Ranchos is distinguished from the La Villa by the increase in sandstone and by the color change in the claystones from mottled red and gray to red and dark gray. Greenish-gray and green claystones appear near the base of the formation. The difference in sand content over that of the La Villa increases toward the south, until, in Calcaño-1, where there is no color change, the sand content is the only lithic criterion. Exceptions do occur; near Macoa, where the La Villa consists of a sand and gravel facies, the top of the Los Ranchos had to be arbitrarily placed at the top of the interbedded red and gray claystones and gray sandstones.

The Los Ranchos carries a variety of suites, the predominant one being the andalusite-kyanite Suite. Other suites occur, depending upon the sporadic occurrences of epidote and the aluminum silicate metamorphics. In general these more complex suites occur in the southern part of the region (García-1 and Calcaño-1) becoming very simple in the center (predominantly simple with garnet and staurolite in Covir-1 and Neopod-1) and more typical in the north (persistent andalusite-kyanite Suites in Cacuz-1).

The more complex suites of the Los Ranchos distinguishes this formation from the La Villa; in the south where both formations carry related complex suites, the Los Ranchos normally carries fairly persistent garnet and sporadic chloritoid, both of which are absent or sporadic in La Villa.

The Los Ranchos is essentially barren of fossils; only a few scattered occurrences of Haplophragmoides, Trochammina and Bathysiphon have been recorded from various wells. For this reason, the Barren zonule of the Lagunillas has been applied also to this formation.

Although there is not sufficient well information concerning the gradation of the Los Ranchos into the upper Lagunillas, still, certain characteristics are sufficiently correlatable to permit this conclusion. The lithology is similar to that of the Lagunillas except for the addition of light green claystones throughout the upper section of the Lagunillas. These green clays occur in only the lower part of the Los Ranchos. The mineral suites are andalusite-kyanite Suites. The top of the epidote in the Lagunillas almost coincides with the change to olive green claystones, which change represents the formational change from the Los Ranchos to the Cuiba formation of the El Fausto group.

The El Fausto Group

The El Fausto group (Hedberg and Sass, 1937, p. 101) contains from top to bottom the following formations: the Cuiba, the Macoa, and the Peroc. Each of these formations will be discussed separately below. As mentioned before, the El Fausto has been considered as the lateral equivalent of the Icotea formation, pinching out rapidly eastward, in order to grade laterally into such a thin formation, and underlying the La Rosa when present. The writer puts forth the concept that the Cuiba is equivalent to the lower Lagunillas, that the Macoa is the lateral equivalent of the La Rosa, and that the Peroc pinches out eastward, equivalent in part to the Icotea formation. The basal sandstone of the Peroc is very similar, lithologically and mineralogically, to the Icotea. Obviously they are not time equivalents but the two are considered to represent a terrestrial transgressive phase in the early and middle Oligocene. In the area of Boscán field, the Lower Member, Peroc, pinches out against, or into, the basal sandstone of the Lower Member (or Icotea) first, followed by the other two overlapping members pinching out successively eastward,

between Larrain-1 and the shore line of the Lake.

The Cuiba Formation

Like the Los Ranchos formation, the Cuiba formation (Mencher et al., 1951, correlation chart) also occurs in the western part of the area and changes eastward into the lower part of the Lagunillas formation. The Cuiba formation is similar to the lower Lagunillas in that the lithology is characterized by mottled red, olive green and light green claystone with scattered quartz grains. Toward the south of the region, the predominantly green colors give way to red and gray with only vestiges of the green left in minor beds of green, olive, and bluish-green claystones. In the north, the change in color, and the presence of abundant anhydrite, marks the top of the Cuiba as different from Los Ranchos, but in the south, with only minor green colored beds for identification, the top is placed at the base of the continuous sandstones of the Los Ranchos. The tan and gray sandstones that occur occasionally in the Cuiba are not usually confused with those of Los Ranchos.

In a few wells, Neopig, Neopod and Covir, it was noted that between the Los Ranchos and Cuiba sediments there occurred a section of dark gray, fossiliferous shale. The writer has placed the shale section with the Cuiba formation, because of the more marine character of the Cuiba, and has called it the Cuiba shale facies.

The presence of persistent epidote and related zoisite distinguishes the Cuiba from the Los Ranchos. The andalusite and kyanite, strong in Los Ranchos, occurs in only the upper part of the Cuiba, and decreases in frequency with depth. In the lower part of the Cuiba, the zoisite-epidote decreases, causing sporadic simple Suites with staurolite to appear. The Covir-Neopod area, anomalous to the rest of the area, contains essentially simple Suites with staurolite.

The Cuiba section contains occasional brackish-marine beds that carry Miliammina fusca Brady, Ammobaculites, Ostracod and Gastropod faunas, called Miliammina fusca horizons. In the southern part of the area, there is a persistent Ammobaculites horizon just below the top of the formation that provides a good correlation point; in the central part, the Cuiba shale contains fair faunas of Miliammina fusca, Ammobaculites, Haplophragmoides, Ostracods, and Gastropods; and in the north Miliammina fusca occurs in scattered beds throughout the section, usually without much stratigraphic significance. The Gastropod zonule of the lower Lagunillas evidently disappears westward, although Gastropods are found scattered through the lower Cuiba section.

The Macoa Formation

The Macoa formation (Mencher et al., 1951, Correlation Chart) is considered by the writer to be the western equivalent of the La Rosa formation, the facies change from the Macoa to the La Rosa being in the vicinity of the Boscán field. The thickness varies from 150 feet in the northwest near Totumo and 200 feet in Boscán, where it changes facies into La Rosa, to about 1150 feet in the south.

The Macoa is distinguished from the overlying Cuiba or Lagunillas by the presence of dark gray to brown shale. Although the Macoa also contains green, red and gray claystone and siltstone, the shale is usually predominant over the

claystone. Toward the southwest, the color of the gray shale changes to green, as in the La Rosa, and the formation, as it becomes thicker, consists of more lithic types. For example, in Alturitas-1, the Macoa contains not only various colors of shale, but also lignite, claystone, and sandstone in more or less equal proportions.

Heavy mineral data are scarce on this formation due to being primarily shale, but sandstones show that the complex suites in the east change gradually to the simple suites with garnet in the south (Figure 5).

The mineralogy is similar to that of the upper La Rosa formation; where epidote suites with garnet and staurolite predominate.

The faunas of the Macoa consist principally of fish teeth and remains with occasional local occurrences of Ammobaculites and Ostracods. Even though there is a paucity of species of fossils, the remarkable persistence of the fish teeth over the entire region provides an excellent means of correlation and has been termed the Fish Remains zonule A.

The change in facies from the Macoa to the La Rosa can be seen very well in the Central Area (Figure 6), where a tongue of dark gray, fish-teeth bearing shale overlies the typical dark green shale, carrying the representative Rotalia beccarii fauna of the La Rosa. This tongue evidently pinches out between Boscán field and Larrain-1 to the east.

The Peroc Formation

The Peroc formation (Mencher et al., 1951, Correlation Chart), oldest of the El Fausto group, occurs throughout the western part of the region and pinches out eastward in the vicinity of Boscán, where it is replaced in part by the Icotea formation. The relationship between the Lower Peroc, the Peroc basal sandstone and the Icotea is mentioned under the heading of the El Fausto group. The thickness of the Peroc formation along the mountain front is fairly constant, between 3600-3900 feet, and it thins gradually eastward, until it is only about 300 feet (not including the basal sandstone-Icotea section) in Boscán and Larrain, before completely pinching out. The Peroc has been divided into three members, Upper, Middle, and Lower, on the basis of their lithologic characteristics. The Middle Member has a lithology similar to the Macoa, while the Upper and Lower Members consist of claystone sections of different colors.

Upper Member

The claystone of the Upper Member is predominantly tan in color with minor mottled beds of red, gray, purple, pink and white. It is markedly different from the overlying Macoa or La Rosa in the northern area, but in the extreme south, the Upper Member consists of green shale and claystones interbedded with light brown, brown, purple and gray claystone. In this case, the top of the Upper Member is placed at the top of the light brown claystone rather than at the base of the shale as is usual in the north.

The Upper Member is characterized by the simple Suite with or without staurolite and garnet, although slightly more complex suites do occur. Epidote Suites evidently only occur in the uppermost part as an overlap of the Epidote Suite zone of the Macoa formation, and Normal Garnet Suites occur in the Macoa area with the addition of chloritoid to the normal suite.

The Upper Member is barren of fossils.

Middle Member

The Middle Member is a shale unit similar to the Macoa formation. Although the member does contain tan claystone, light gray siltstone, and lignite, the predominance of dark gray and greenish gray shale is adequate to determine it from the other members.

The mineralogical characteristic of this member is the presence of normal garnet and chloritoid, forming the Normal Garnet Suite. The Normal Garnet Suites occur only along the mountain front, and become simpler, that is, change to simple plus garnet, as they approach the facies-change of the Icotea formation.

The fauna of this member, designated the Fish Remains zonule B, is persistent in its occurrence and consists primarily of fish teeth, with only rarely occurring Ammobaculites and Miliammina fusca. There is one marine facies layer in this member, to date found in only one well, which contains Oligo-Miocene species of Rotalia beccarii and Elphidium.

Lower Member

The Lower Member is very variable in its lithology and contains a considerable number of rock types; however, the beds underlying the Middle Member usually consist of red and gray claystones with minor amounts of purple, brown, tan, yellow and green. With depth, there is a series of intercalated shale, claystone, siltstone, sandstone and lignite beds with minor bluish-tan limestone and argillaceous limestone. Toward the base, a greenish mudstone or claystone is dominant, and at the base there is whitish-gray, locally green, sandstone, siltstone, and claystone. This unit is called the Peroc basal sandstone and is considered equivalent to the Icotea formation.

The normal Lower Member carries two suites: the simple Suite without garnet in the upper two-thirds of the unit, and Normal Garnet Suites (normal garnet and chloritoid) in the lower third of the unit. In the south, where the Lower Member becomes very shaly, the Normal Garnet Suites extend higher in the section or perhaps occur through the entire member, but this is unusual in the normal section.

Scattered rare faunas occur throughout the member, but occur especially in the shale and lignitic shale beds that comprise the Fish Remains zonule C. This zonule contains fish remains, Ammobaculites, Haplophragmoides, Miliammina fusca, Ostracods, and very rare Saccammina and Ammodiscus. Most of the faunas occur in the south along the mountain front, but Ostracods and Miliammina fusca occur also to the north in the lignitic beds. To the east, the zonule pinches out and the member is almost completely barren.

The development of the mineral facies of the Icotea and Peroc provides an interesting study of facies in mineral-stratigraphy. Figure 5 shows the change from the simple Suites of the typical Icotea to simple Suites with garnet in the lateral lithic facies change to the Middle Member and, farther west, the addition of the lower garnet horizons of the Lower Member. These simple suites plus garnet horizons change gradually westward, with the occasional occurrence of chloritoid, to Weak Normal Garnet Suites and finally, along the mountain front to Normal Garnet Suite.

The Lagunillas Formation

As mentioned above, the Lagunillas formation (Hedberg and Sass, 1937, p. 108) is considered to be the lateral facies of both the Los Ranchos and Cuiba formations. Limited to the eastern part of the area, the change in facies takes place from east to west along a line through the Boscán area. The thickness varies considerably, thinning from 3300 feet (Boscán field) in the west to 700 feet (Icotea-1) in the east.

The upper part of the Lagunillas (Los Ranchos equivalent) consists of mottled light green, red and buff claystones, with the green color predominant; the lower part (Cuiba equivalent) contains the olive green claystones, which are so characteristic of the Cuiba, in addition to the others. The top of the anhydrite occurs with the color change and continues persistently through the lower part. The persistent anhydrite is also characteristic of the Cuiba formation.

The Lagunillas is differentiated from the La Villa by presence of the light green claystone, and mineralogically, by the presence of Andalusite-Kyanite Suites. However, when the La Villa contains more complex suites than normal (as in the south), in general, so will the Lagunillas carry a suite slightly more complex than normal. Below the "Top of Epidote," the suite is still more complex consisting usually of kyanite, andalusite, epidote suites with normal garnet and chloritoid.

Most of the Lagunillas is barren of fossils, but in the lower half of the formation there are occasional beds of Miliammina fusca. These beds are not stratigraphic equivalents since they seem to occur at different positions in the section, but they do indicate the change in facies from the non-marine upper part to the brackish-water lower part of the formation. The basal part was deposited in a brackish-marine water environment and contains a faunule of Gastropods, Pelecypods and Ostracods, with rare Ammobaculites. The top of this Gastropod zonule does not apparently have much correlative value due to occasional variation in stratigraphic position, although generally, along the lake-shore it occurs between 100 feet to 150 feet above the base of the formation.

The La Rosa Formation

Occurring in the eastern part, the La Rosa extends from the lake-shore to the Boscán field where it changes laterally into the Macoa. Along the lake-shore, the thickness is more or less consistent, about 200 feet, thickening slightly westward to about 250 feet and southward to about 400 feet.

The formation can be distinguished from the overlying Lagunillas by the presence of green to dark greenish-gray clay-shale. The green and greenish gray sandstones are very similar to those of the Lagunillas. For that reason, the La Rosa boundary might not always be consistent when sandstone constitutes the uppermost part of the formation as the sandstone would probably be determined as Lagunillas.

The paleontology is represented by the Rotalia beccarii zone, which extends from the top to the bottom of the formation. The zone contains Rotalia beccarii, Textularia, Cibicides, Eponides, Ammobaculites, and fish remains, Ostracods, Gastropods and Pelecypods. In this area, the faunas vary from fairly rich to very poor in the matter of 1000 meters. No zonules or subdivisions can be made within the Rotalia beccarii zone and in this area the changes in faunas appear to be lateral variations rather than vertical or stratigraphic changes.

This formation is represented mineralogically by the related associations of epidote, andalusite, kyanite, chloritoid, and normal garnet. Occasional horizons of glaucophane also occur, but without regard to any stratigraphic position as it does in the Bolívar Coastal Field wells where it often represents the Santa Bárbara sand.

The Icotea Formation

As mentioned above, the Icotea formation (Hedberg and Sass, 1937, p. 104), as equivalent to the Peroc formation, occurs only in the eastern part of the area. The thickness varies normally from 150 feet to zero, where it pinches out, but it attains about 300 feet of thickness in the area of facies change into the Peroc.

Like the basal sandstone of the Peroc, the Icotea consists of white to light gray siltstone and claystone, with occasional beds of green claystone. The whitish color of the siltstone distinguishes it from the overlying Peroc (green and brown sandstones and siltstones) and from the La Rosa (shale and greenish gray sandstone).

The Icotea formation normally carries a Simple Suite, although other related suites occur typically, but rarely, with or without garnet and staurolite.

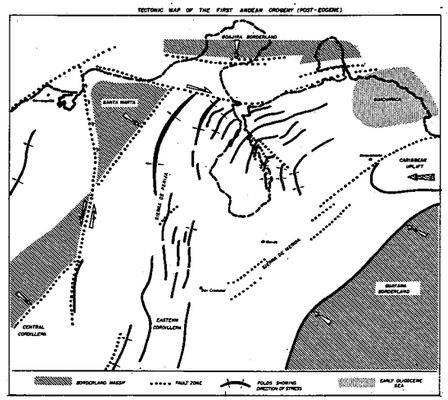

Figure 7. G. Young. Paleogeographic and tectonic map showing the post-Eocene surface upon which the Oligocene Peroc and Icotea formations were deposited.

REFERENCES

FEO-CODECIDO, G. (1956): "Heavy Mineral Techniques." AAPG Bull., vol. 40, no. 5, pp. 984-1000.

GARNER, A.H. (1926): "Suggested Nomenclature and Correlation of the Geological Formations in Venezuela." AIME Trans., pp. 677-684.

GONZALEZ DE JUANA, C. (1952): "Introducción de Estudio de la Geología de Venezuela; Cuarta Parte." Bol. Geol., vol. II, no. 5, pp. 311-330.

HAAS, M.W. y HUBMAN, R.G. (1937): "Notas sobre la Estratigrafía de los Campos Costaneros del Distrito Bolívar, Cuenca de Maracaibo, Venezuela." Bol. Geol. y Min., tomo I, nos. 2,3,4, pp. 123-164.

HEDBERG, H.D. y SASS, L.C. (1937): "Sinopsis de las Formaciones Geológicas en la parte occidental de la Cuenca de Maracaibo." Bol. Geol. y Min., tomo I, nos. 2,3,4, pp. 77-120.

HOFFMEISTER, W.S. (1938): "Aspecto y División en zonas de la fauna de Moluscos en las formaciones La Rosa y Lagunillas, Campos Costaneros de Bolívar, Venezuela." Bol. Geol. y Min., tomo II, nos. 2,3,4, pp. 103-121.

KUYL, O.S., MULLER, J. y WATERBOLK, H. Th. (1955): "The Application of Palynology to Oil Geology with Reference to Western Venezuela." Geologie en Mijnbouw, vol. 17, no. 3, pp. 49-76.

LIDDLE, R.A. (1946): "The Geology of Venezuela and Trinidad." 2nd edition, Paleontologic Research Institution, Ithaca, New York.

MENCHER, E. et al., (1951): Convención Nacional de Petróleo. Min. de Minas e Hidrocarburos, Caracas; pp. 1-80.

MILLER, J.B., EDWARDS, K.L., WOLCOTT, P.P., ANISGARD, H.W., MARTIN, R. y ANDEREGG, H. (1958): "Habitat of Oil in the Maracaibo Basin, Venezuela." Presentado ante la asamblea de la AAPG, New York, en marzo de 1955; publicado 1958, AAPG, "Habitat of Oil, a Symposium."

MILLER, J.B. (1956): Autor de algunos artículos en el Léxico Estratigráfico de Venezuela; Min. de Minas e Hidrocarburos, Publ. Especial no. 1.

RENZ, H.H. (1940): "Stratigraphy of Northern South America, Trinidad and Barbados." Proceed. Eighth Amer. Scientific Congress, vol. IV, pp. 13-571.

RENZ, H.H. (1957): "Stratigraphy and Geological History of Eastern Venezuela." Geol. Rundschau, Südamerika Heft, vol. 45, no. 3, pp. 728-759.

SCHAUB, H.P. (1958): "Outline of Sedimentation in Maracaibo Basin, Venezuela." AAPG Bull., vol. 32, no. 2, pp. 215-227.

SUTTON, F.A. (1946): "The Geology of the Maracaibo Basin, Venezuela." AAPG Bull., vol. 30, no. 10, pp. 1621-1739.

RECTIFICACIONES Y COMENTARIOS

Bol. Inf. Vol. I, No. 3:

1. The caption of Figure 4, page 76, infers that the Uribante fault of Rod is the same as the Morita fault of O. Renz. This is an editing error; the Morita fault[1] is a small fault east of the Río Doradas and should not be confused with the Uribante fault of Rod.

2. Compilation maps, Figures 9, 10, and 11. It should have been mentioned in the Conclusions that these maps represent a compilation of the detailed work that has been published or was offered to the Asociación during the round-table discussion of the Boconó fault. Figure 9, which was compiled by G.A. Young and W. Petzall, represents the work of J. Bushman, E. von der Osten and C.Jefferson. Figure 10, compiled by W. Petzall and G.A. Young, represents the detailed work of C. Jefferson and an interpretation (Young) of the possible fault trend from Mucuchíes to Mérida. Figure 11, compiled by Young, is a conciliation of the work of Alberding, O. Renz, Rod.

Bol. Inf. Vol. I, No. 4:

To further the idea of obtaining and presenting as much information on the geology of Venezuela as possible, the Editor has asked different workers to present their ideas on some of the major faulting in the Andean region on the same Shell base-map as the Compilation maps mentioned under Point 2 above. Comparison of, and the localization of, fault traces are difficult when shown on a generalized sketch map and for that reason the contour and form-line map of Shell was selected to determine the traces with more precision.

For this issue Dr. O. Renz has kindly offered his information on faulting in the Venezuelan Andes. Only the main faults, or fault zones, in which we have become interested in the recent discussions, are depicted on Figures 8 and 9. The details of the faulting and the adjacent or auxiliary faulting have not been indicated on the map, which helps to present a clear picture of the principal fault trends.

G.A. Young
Editor

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[1] See Fig. 11, O. Renz, (presented 1956): "Cretaceous in western Venezuela and the Goajira (Colombia)." Presented before the XX Session, Internat. Geol. Congr., Mexico City.

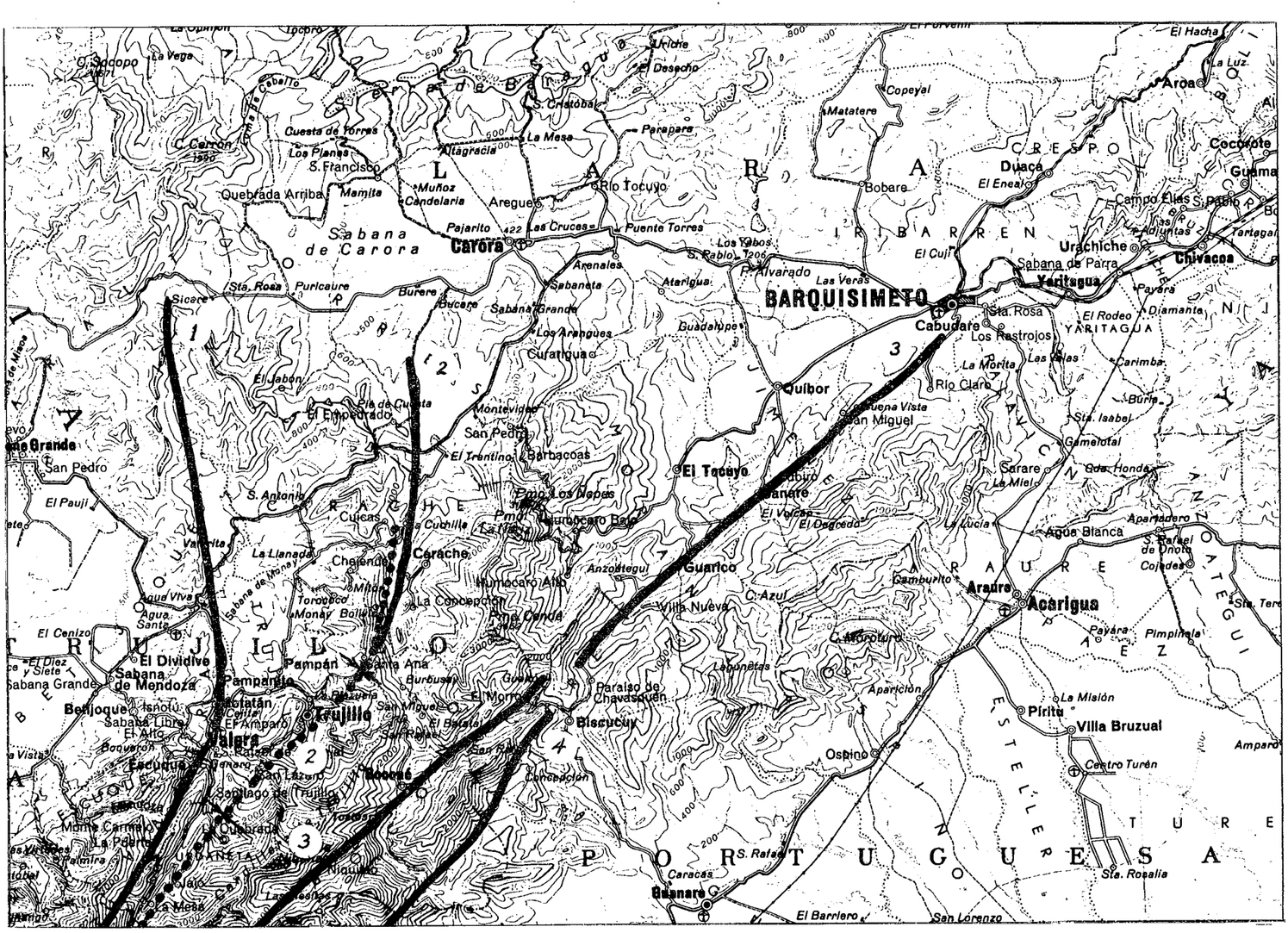

Figure 8. O. Renz. Map of a few of the main fault zones in the Venezuelan Andes.

1. Merida - Valera fault zone
2. San Jacinto syncline, connected with abundant faulting (Boraure fault)
3. Boconó fault zone
4. Cerro Azul fault

Figure 9. O. Renz. Map showing a few of the main fault zones in the Venezuelan Andes (continuation of Figure 8.).

1. to 4. Faults of Fig. 8.
2. Caparo fault
3. Libertad - El Hato fault
7. Zea fault
8. San Buena fault

NOTICIAS

Consejero

La Junta Directiva tiene el placer de anunciar que el Dr. Leo Weingeist ha aceptado el puesto de Consejero que dejó vacante el Sr. F.W. Johnson, quien ha sido transferido a los laboratorios de investigaciones de la Standard Oil of New Jersey.

Representantes

Se nombró al Dr. Royo y Gómez como representante nuestro ante la Universidad Central de Venezuela.

XX° Aniversario del Departamento de Geología, UCV

Nuestra Asociación ha sido invitada a tomar parte en los actos conmemorativos que por motivo del XX° Aniversario de su fundación, la Universidad Central llevará a cabo del 23 al 25 del presente mes. El programa provisional de dichos actos será el siguiente:

23 de octubre (Día jueves): Acto académico en la Universidad Central.

24 de octubre (día viernes): Comida o un coctel.

25 de octubre (día sábado): Fiesta vespertina organizada por la Sociedad de Estudiantes de Geología, Minas y Metalurgía.

Se espera su presencia y colaboración.

III Congreso Geológico Venezolano

La Sociedad Venezolana de Geólogos está organizando el III Congreso Geológico Venezolano, que se celebrará en Caracas durante los días 1° al 7° del mes de Septiembre de 1959. La Comisión Organizadora pidió de nuestra Asociación la designación de un grupo de técnicos que estuviesen interesados en trabajar con la Comisión en la preparación y ejecución del Congreso, el que será de gran interés para los profesionales de la Geología, Minería, Petróleo e Ingeniería. Se ruega que los miembros interesados dirijan sus cartas al Secretario, Sr. D.J. Shriner, Apartado 267, Caracas, o llamen por teléfono 81-91-51.

MIEMBROS

En la reunión del 2 de octubre de 1959, la Junta Directiva aceptó a las siguientes personas como miembros activos:

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