

**Zeitschrift:** Eclogae Geologicae Helvetiae  
**Herausgeber:** Schweizerische Geologische Gesellschaft  
**Band:** 56 (1963)  
**Heft:** 1

**Artikel:** Contribution to the geology and paleontology of the area of the city La Habana, Cuba, and its Surroundings  
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**Kapitel:** Neocomian limestones  
**DOI:** <https://doi.org/10.5169/seals-163038>

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Las Villas Province, evidence of contact metamorphism in late Senonian sediments. On the other hand, diorite pebbles occur in Maastrichtian beds (= "Habana formation" of previous authors), and it appears that the main intrusive phase took place during the late Senonian. It was not possible to ascertain whether or not in the Habana area the diorites intruded into the pre-Vía Blanca and/or the Vía Blanca formation.

### *Neocomian limestones*

About 2 km due west of Santa María del Rosario, a small town in the east of the Habana area, a narrow east-west striking ridge is formed by vertical, strongly fractured and tectonically squeezed beds. The coordinates of a road cut across this ridge are 359.58 N and 369.06 E. The core of the ridge consists of a series of gray thin-bedded Neocomian limestones with black nodular chert. On both sides of this limestone, BR station 1118, there are gray and brown shales, some tuffaceous sandstones and thin beds of lighter colored limestones of Upper Cretaceous age.

From this road cut are the following random samples:

BR station 1118

- (1) Lithology: Limestone, hard, dense, fractured, light gray to medium gray, with black nodular chert.

Texture: Cryptocrystalline groundmass with incipient dolomitization. Strongly fractured. Rock-forming *Nannoconus*.

Assemblage: *Nannoconus steinmanni* KAMPTNER (abundant)

*Nannoconus globulus* BRÖNNIMANN (rare)

Radiolaria (recrystallized)

- (2) Lithology: Limestone as above.

Texture: Cryptocrystalline groundmass. Fractured. No *Nannoconus*.

Assemblage: Nondescript remains of planktonic Foraminifera, Radiolaria.

BR station 1119 (shale north of limestone ridge)

Lithology: Shale, soft, non-calcareous, dark yellowish brown, with calcite crusts. Barren.

BR station 1120 (light colored limestone south of the *Nannoconus* limestone)

Lithology: Limestone, hard, dense, fractured, very light gray to yellowish gray.

Texture: Cryptocrystalline groundmass, strongly fractured, with abundant recrystallized planktonic Foraminifera.

Assemblage: *Globotruncana fornicata* PLUMMER

*Globotruncana* cf. *linneiana* (D'ORBIGNY)

*Globotruncana* cf. *marginata* (REUSS)

*Globotruncana stuarti* (DE LAPPARENT)

"*Globigerina*" sp.

"*Globigerinella*" sp.

*Heterohelix* sp. or *Pseudoguembelina* sp.

This isolated outcrop is the only exposure in the Habana area of Neocomian limestones of the *Nannoconus steinmanni* zone. It is of deep-water facies and typical of the Neocomian limestones throughout Cuba. Its field-relationship with

the younger sediments and with the serpentinites to the south are not known. It appears not to be in situ and may be either a slip mass within Vía Blanca beds or a tectonically dislocated mass, for which we did not introduce a new formational unit and name. Similar lithologies with *Nannoconus steinmanni* KAMPTNER were seen by us also in the uplift west of Habana, on the old road from Guanajay to Mariel, where they are likewise associated with Upper Cretaceous limestones and with serpentinites. Another occurrence of reworked Neocomian limestones close to the Habana area is represented by large subangular limestone blocks and pebbles with *Nannoconus steinmanni* KAMPTNER and Neocomian calpionellas in an arkosic conglomerate outcropping in a road cut of the Vía Blanca, 1.9 km northeast of the bridge over the Canasí river in northwestern Matanzas Province. Allochthonous specimens of *Nannoconus* were encountered in younger calcilutaceous sediments suggesting that Neocomian limestones were outcropping elsewhere in or close to the Habana area during the Upper Cretaceous.

The Neocomian limestones must have been deposited before the serpentinites were covered by the Cenomanian (?) to Turonian shales, radiolarites, silicified limestones and graywackes of the pre-Vía Blanca beds. The section described from the north flank of the Regla-Bacuranao uplift may be incomplete, and assuming that the ultramafics form the local basement, Neocomian limestones and perhaps older, possibly Jurassic beds, may still be found resting in structurally low areas on the serpentinites and overlain by the pre-Vía Blanca beds. The stratigraphic and structural problems posed by this singular exposure of Neocomian limestones cannot be solved in the Habana area.

Apart from the dark colored and thin-bedded Cenomanian (?) to Turonian shales of the pre-Vía Blanca series, and perhaps some shales of the Vía Blanca Formation, the Neocomian limestones are believed to be the only petroleum source rocks of the Habana area. The Neocomian limestones are dark-colored, fine-grained sediments of basinal environment to a large extent formed by the remains of planktonic organisms, and provided that reducing conditions prevailed during their deposition they may have generated hydrocarbons. These limestones or paleoecologically similar sediments of Cretaceous and Upper Jurassic age, such as the ammonite-bearing Oxfordian Jagua formation of Pinar del Río Province, are assumed to be the source of the petroleum produced today from the fracture systems of the serpentinite uplifts of northern Cuba, and seeping from the fractures of the Peñalver clastics and of spilitic flow rocks. They are probably also the source for the past submarine seepages which formed the accumulation of asphalt pebbles and the fracture fillings in the Universidad beds and in some of the younger beds (reworking from the Universidad formation ?) of the Marianao group of formations.

#### *Pre-Vía Blanca Beds*

Under the rather general term pre-Vía Blanca beds are here included the strata resting apparently unconformably on the serpentinites and which are overlain unconformably by the Vía Blanca formation. The pre-Vía Blanca beds are an heterogeneous group of lithologies consisting of indurated, in part siliceous shales, silicified limestones, radiolarites, opal, graywackes, tuffaceous beds, flow rocks and