PRESENCE OF A NEOAUTOCHTHONOUS SUPERSTRUCTURE IN PART OF CENTRAL CUBA (CIEGO DE AVILA—CAMAGUEY)

V. T. Kostadinov

Geological Institute, 1113 Sofia

Geological investigations (1979—1981) carried out in the central part of Cuba—the former Camaguey Province, yielded quantitatively new information on the lithostratigraphy and tectonic structure, including relations between structural-facies zones, structural plans, structure-building events, etc. The results of their complex interpretation extend beyond the boundaries of the territory studied. The present discussion is focused mainly on the general tectonic environment and the post-Lower Campanian development of the area of the former island arc (Zaza zone) and the former continental margin (Placentas, Camajuaní, Remedios and Cayo Coco zones) on the north. From the end of the Upper Cretaceous new conditions, equalized in respect of the pre-existing basement, were superimposed in this area. They were more contrasting on the territory of the former island arc while north of the Camajuaní-Cubitas fault, on the continental margin (the southern periphery of the Bahamian platform—Turrall & Vincent, 1975; Aubouin & Tardy, 1980), the conditions were of a more transitional character.

The territory of Central Cuba exhibits a complex tectonic pattern. A large variety of structures—result of several intensive structure-building phases, have been established. The available data are still insufficient to prove which type of movements prevailed but undoubtedly the horizontal ones were of importance and may be of leading role. The information on the deep structure, irrespective of the existing deep boreholes, is still insufficient. The analysis of the gravimetric surveys (Soloviev et al., 1964; Сажина et al., 1965; Ипатенко et al., 1971) and of other tectonic and geophysical, interpretations (Ferrazola-Bermúdez et al., 1964, Meyerhoff & Hatten, 1968; Левченко & Рябухин, 1971; Шапошникова, 1974; Mattson & Lewis, 1980, etc.) leads to the conclusion that the larger part of the section of the volcano-genic-sedimentary and intrusive complexes of the island arc (Zaza zone) is already in allochthonous position after the Lower Campanian. This becomes evident when we examine also the chronologic relations between the island arc and the continental margin, and the located between them rocks of the ophiolitic association, extracted from depth along a thrust plane. As fragments of an ancient oceanic lithosphere, their contemporary position on the surface, directly north of Zaza zone, may be explained most logically likewise by allochthonous position. Apart from geophysical data (Шапошникова, 1974) the thrusting is confirmed also by a number of geological facts. Adjacent to and in the Camajuaní-Cubitas fault zone, the present front of the thrusting, many structural features point out to an allochthonous position. There is an active tectonic reworking and incorporation of strongly dislocated sheet-like bodies mainly in the ophiolitic complex. Such are also the large fragments of the former Placentas structural-facies zone which were evidently tectonically assimilated during the thrusting. Directly north
of the thrust front (the former Remedios and Cayo Coco zones) the area shows a typical para-autochthonous structure — numerous imbrications, overthrusts, local nappes of small amplitude and isocline folds, all of northern vergence (Iturralde-Vinent & Roque Marrero, 1982).

After an intensive structure-building event, most probably after the Lower Campanian, the thrust relay (the former volcanic island arc upon the continent on the north, they were welded together into a continental block of complex structure. A new sedimentation regime was superimposed from the Upper Campanian to present days. The distribution of the younger rock complexes does not coincide and is not confined within the boundaries of the latter, mainly faulted, were to a large extent deprived of their limiting until then role. The new, relatively quiet period was broken by several structure-building events as a result of which the dominating on the surface geological structures were formed (Fig. 11-1).

The tectonic environments created after the Upper Campanian, including particular lithostratigraphic units and tectonic structures, upon the Subhercynian allochthonous rocks of the former continental margin (Remedios and Cayo Coco zones) are of neoclastic character. Depending on the intensity of the later movements, on the character of structural parageneses and their features, an early and a late neoclastic stage may be divided in the geochron Upper Campanian-present days. On the background of the continental period they correspond to two development stages and structure-building events — transitional continental and continental (conformable). The first represents the time from the Upper Campanian to the middle of the Eocene (and Upper Eocene only east of Camagüey zone) and the second — from the Upper Eocene (Oligocene) to the Quaternary inclusive.

TRANSITIONAL CONTINENTAL STAGE (EARLY NEOAUTOCHTONE)

This stage is typical of the southern periphery of the Bahamian plate, i.e. of the southern and not yet stabilized part of the continental margin, considerably thicker after the Subhercynian movements. Here, the tectonic processes did not fade out and were still rather intensive. Compression and extension stages repeatedly changed. The basins, particularly during the Early Paleogene, were of marked linearity. The sedimentary complexes deposited in them were later intensively deformed. In that stage, both during the sedimentation and the structure-building processes, the transversal La Trocha and Camagüey faults, evidently of ancient origin, played important part. They are fault zones of different width and show complex structure, though not expressed on the surface in some places. They preclude the subdivision of this part of Central Cuba in three megablocks — west of La Trocha (the larger part being outside the region), Florida and Sibancu. They show different behaviour during the individual stages of Paleogene development. Until now Florida and Sibancu megablocks have been described as a single block structure — Camagüey horst block (Iturralde-Vinent, 1979).

Along the transversal La Trocha and Camagüey cryptofaults repeated vertical movements and in some moments — horizontal displacements of small amplitude took place. The sign of movements changed and in this way the faults controlled the formation of lithostratigraphic units and structural stages. As a result of vertical movements along the transversal faults a nearly complete section of the Paleogene is exposed in the megablock west of La Trocha, only Middle Eocene and in parts Lower Eocene (north of Cubitas fault) sediments — in Florida megablock, and only Middle and Upper Eocene and isolated Oligocene occurrences — in Sibancu megablock. The longitudinal Camagüey-Cubitas fault also played a certain paleogeographic role during the Paleogene.

Depending on the represented lithostratigraphic units and the established sedimentation breaks and unconformities within the Early Neoautochthone, three structural stages are distinguished — Upper Campanian-Maastrichtian (Lower Paleocene), Paleocene-Middle Eocene and Paleocene-Upper Eocene. Each of them shows specific features and a definite position in the general environment. They include a wide range of formations, are well spatially individualized and contain different though sharply contrasting structural parageneses. The latter result from the structure-building phases after the Upper Cretaceous, in the end of the Middle Eocene and after the Upper Eocene.

The chronostratigraphic range of the formations which form the Early Neoautochthone and the range of the respective structural stages is different in individual megablocks or parts of them. This is due to their different behaviour during the erosion periods after the respective folding phases. The duration of denudation was related to the dissemination of the newly formed relief, as well as to the rate and amplitude of vertical movements along the transversal (La Trocha and Camagüey) and longitudinal (Camagüey-
In the end of the Middle Eocene a new northward thrusting along Camajuani-Cubitas fault occurred as a final response to the collision between the former volcanic island arc and fragments of the oceanic crust, and the continental margin on the north. This is the second in importance and intensity activation of the line dividing them. The amplitude of this last thrusting cannot be accurately evaluated due to lack of borehole data. Directly in front of the thrust a number of narrow, subparallel folds formed in the Upper Cretaceous rock complexes of Remedios Group (Iturralde-Vinent & Roque Marrero, 1982). Narrow bands of Lower and Middle Eocene sediments are also preserved in the synforms. In most cases they are semi-grabens with southern monoclinal dips bound by northvergent overthrusts and thrusts of small amplitude. In northern direction, with increasing distance from the frontal zone, the intensity of folding and thrusting gradually decreases.

In the end of the Middle Eocene there was also northvergent overthrusting along Los Perijes fault north of Arroyo Blanco. A number of transversal to oblique faults of small length are synkinematic to the folds. At the beginning of the fault zone the fault faults originated (east of Vertientes). The shortening of the crust during that structure-building phase was not large. The direction of maximum horizontal compression was northeast-southwest. Later, the area west of Camajuani fault uplifted. The duration of the erosion period was different in individual parts of the region studied. It must be pointed out that Florida megablock, after the active movements in the end of the Middle Eocene, emerged almost entirely from the waters until the Miocene. The Paleocene-Eocene structural stage is developed only in Sibanicu megablock, east of Camajuani fault zone. It includes Maraguan (Middle Eocene) and Saramacuan Formation (Middle-Lower Eocene) in the northern and Guaiamanar Formation (Middle-Lower Eocene) in the southern part of the megablock. Nearly over the whole area of the megablock the sedimentary environment, existing during the Middle Eocene, was preserved also during the Upper Eocene. Neither breaks in the sections nor considerable changes in facies have been established. This shows that the folding phase after the Middle Eocene did not affect this area. The main structure-building event in this megablock occurred in the end of the Upper Eocene and corresponds to the Pyrocone phase. Mainly fold structures of considerable size were formed — Najasa and San Miguel de Baga anticlines and Redencion syncline. They are of normal vergence and submeridional direction. Their western parts are cut by Camajuani fault. These structures evidently continue to the east, in Las Tunas Province. The direction of the maximum horizontal compression was north-south. In the southern part of the megablock between Jagua and Arroyo Blanco del Norte, on the background of the subequatorial band of Guaiamanar Formation, folds of second-order are developed which show the character of hemianticlines and hemisynclines. They are of meridional direction and with hinges, pitching steeply to the south. They may result from right-lateral strike-slip along Camajuani fault zone. Some translational to oblique faults of not very large dimensions are synkinematic to the folding. After the folding in the end of the Upper Eocene the Sibanicu megablock (without the area around Nuevitas) was uplifted and subjected to denudation until the beginning of the Miocene.

**Continental Stage (Late Neoautochthon)**

After the main longitudinal (with respect to the island) fold structures were formed in this part of Central Cuba, the region was already a relatively monolitic and stable continental block (platform — Iturralde-Vinent, 1971, 1981). A relatively quite period followed which is characterized only by differentiated oscillatory movements of different sign. The formation of superimposed depressions of irregular orientation,
different lithology and age of the sedimentary filling are the most typical features of this stage. In places they began to form in the beginning of the Upper Eocene, in others — during the Oligocene or (lower in the west) during the Miocene. Depending on the traces of several well-marked events of regional character three structural stages may be distinguished in the Late Neotachthone — Upper Eocene-Oligocene, Early Miocene and Pliocene-Quaternary.

The Upper Eocene-Oligocene structural stage in the area west of the La Trocha fault includes Marroqui and Ferrer Formations (Upper Eocene) and Tamarindo and Chambas Formations (Oligocene). In the northeastern part of the region, around Nuevaets, it is made up mainly of Nuevaets (Upper Eocene) and in parts Pastelillo Formation (Oligocene).

The transgressive position of Tamarindo Formation upon the Upper Eocene Marroqui and Ferrer Formations, as well as the presence of a basin conglomerate in its base northwest of the Siego de Avila, indicate the effects of the Pyrenean phase. Its intensity in this area, however, is weak — only local short uplift, followed by a new subsidence and change in facies.

The main structures of this structural stage are the three superimposed depressions — Jatibonico, Nuevaets, and Anna Maria — which originated and developed as sedimentary structures. They show different orientation and dimensions. Jatibonico trends northeast-southwest, this direction being predisturbed by flexuring and step-like subsidence to the west, along the La Trocha zone: Nuevaets is northwest-southeast and is superimposed on the northern parts of Florida and Sibanicu megablocks while the depression Anna Maria has the same direction and its larger part remains in the aquatory of the Carribean Sea (Frazolobermudez et al., 1964).

In the end of the Oligocene a new orogenic phase leads to a compression of the waters and a general uplift of the whole territory. At the same time certain faults were formed, mainly of normal-fault character — the normal faults of Arroyo Blanco and Tunico on the west as well as a number of smaller faults to the south and southeast of Tamarindo. The movements along the La Trocha zone were revived — along the faults southwest of Nuevaets, those south of Minas and Redencion, etc. At the same time left-lateral strike-slip of small amplitude occurred along La Trocha as a result of which small folds of equatorial direction, southeast of Tamarindo and northwest of Siego de Avila were formed. After the Oligocene the whole region was at a very high dry land.

The time from the Miocene to present — the following substage in the development of the Late Neotachthone, will be briefly characterized by some more important features.

The Early Miocene structural stage includes the following formations: Arroyo Palmas (Lower-Middle Miocene in the western part of the region and Middle Miocene south of Vertientes), Guines (Middle Miocene) and Magantilla (Lower-Middle Miocene — only east of Camaguey). At that time three new depressions originated: Moron, of northeast-southwest direction, Saramaguacu — east of Camaguey, of subequatorial direction, and Meridional — in the southern coastal part. The latter is of considerable size but of not accurately traced contours and a large part of it lies in the aquatory of the Caribbean Sea. This depression, in the area of Baragua, is complicated by a structural step which divides the structure into two parts — northern and southern. The areas dividing the depressions had different configuration and dimensions. In the depressions, positive and negative forms were formed synsedimentarily. They are flat, of irregular oval ochipiric structures were established (Iturrade Vinzent & Roque Marreto, 1982).

After the Middle Miocene there was a general uplift. It was accompanied by normal faults, not numerous, relatively short and of small amplitude.

The time of the Pliocene and the Quaternary is marked by the occurrence of weak, mainly vertical positive tectonic movements. The Quaternary deposits are diverse, widespread and according to geology correspond to marine, transitional and continental formations. During the Pliocene the whole area was a dry land and intensive paleosolization took place.

During the Quaternary the present morphological pattern of the area was shaped. At present, in individual large areas near the coastal lines, a tendency to subsidence is evident as a result of which large swamps and lagoons on the land and deepening of the adjacent marine basins takes place.

REFERENCES


